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### THE PROBLEM OF RESERVE POWER.

Whenever a central station is fortunate enough to obtain at a reasonable price energy transmitted from a hydroelectric plant, the question of continuity of service is a matter generally given very serious consideration. Actual practice has demonstrated that fears of breakdown on transmission lines usually exaggerate the actual dangers. Many transmission circuits are successfully operated for long periods without anything like a failure of service such as would require to be met by reserve or auxiliary machinery. On the other hand, some lines have undeniably bad records for continuous service and fail often enough and for periods long enough to give great trouble in central-station operation. Between these two extremes there are all grades of operative success. Even with the best transmission systems there is at least such chance for possible breakdown as makes it a part of wisdom to provide a reserve plant of some kind to tide over unwelcome emergencies.

The central at Syracuse described in the current issue is in precisely the situation we have indicated. It is able to buy advantageously energy from Niagara Falls transmitted over two three-phase lines over 150 miles long at 60,000 volts. This energy is purchased on the common basis of a service charge and a consumption charge in addition, so that it becomes necessary for sake of economy to keep the load factor on the substations as high as possible. This means that the local steam station must be prepared to help out during the ordinary peaks and to add power on a much larger scale in case anything happens to the transmission lines. At the station, therefore, there has to be preparation for a normal daily load and an abnormal occasional load. The amount of power purchased from the Niagara circuits is 5000 hp and the steam station must be prepared to carry the peak load above this amount for a few hours per day and must also be ready to take over the whole load in case of need. As to means for this backing up of the service, there is no very general agreement among engineers. A few plants use a liberal storage-battery equipment, others have been equipped with gas engines and still others keep generating units under steam ready to be thrown in when necessary. The Syracuse station pursues an intermediate policy which seems to be effective. It uses as reserve two 1500-kw steam turbines, which are kept floating on the line, operating as synchronous condensers for ordinary use in improving the power factor of the system. When time of need comes, either on account of the daily peak or from temporary difficulty on one of the transmission circuits, these turbines are given their steam and are immediately ready to assume a part or, if necessary, the whole of the load.

The economic situation evidently depends on readiness to furnish on short notice a large amount of steam, while yet not going to considerable expense. In the Syracuse plant this condition is met in a very simple and ingenious manner, bearing in mind the fact that more or less peak load is called for every

day. Enough boiler capacity is kept under steam from regular coal-burning furnaces to deal with any peak load that is likely to be encountered. To meet the fortunately much rarer exigencies in which large capacity is called for, a bank of eight boilers fitted for oil-burning is kept in readiness with the pilot flames lighted. The water in these boilers is kept hot at near the operating pressure by live steam furnished from the coal-burning boiler units just mentioned. In case of trouble with the transmission system, it is only necessary to turn on the oil and in an exceedingly short period the boilers, already hot and filled with steam, can be pushed up to the full capacity necessary. This stand-by system impresses one with its simplicity and effectiveness, and in practice it has demonstrated a satisfactory economy over a system of reserve boilers fired in the ordinary way. It is always ready for business at short notice and at moderate expense, and gives to the station a sense of security even though it may rarely be called on for its full capacity.

### THE TECHNOLOGY OF THE INDUCTION COIL.

The technology of an art is its physical theory shorn of such details as experience has shown to be comparatively negligible for practical purposes. The technology of an art varies from time to time, not merely on account of the advance of physical theory in the direction of the art, but also on account of the advance in the art itself, whereby elements in the fundamental theory which were practically negligible in the earlier stages become indispensable in the later stages. The only important difference between the pure physical and the applied physical theory of a natural process or application is that the pure physicist does not know where to elicit inference and where to ignore; whereas, the applied physicist knows by practical experience what portions can be safely dispensed with. This is merely a difference in local emphasis. The induction coil is a favorite theme of mathematical physics. The physical theory is very complex in its full development, and ramifies into every department of electrical engineering. The choking coil and the transformer were originally dealt with by physicists under the full blast of differential equations of the second or third order, weapons that are of tremendous range, but also of tremendous complexity. Gradually the applied physicists and electrical engineers found by experiment and experience that they could safely lop off a constant here, and neglect a postulate there, until the working theory of these devices in alternating-current service is of a relatively simple and yet effective character. But the moment the local restrictions of the alternating-current circuit are relaxed, back come the train of ignored postulates, like ghosts of the slain to the feast of the conqueror, and again comes the field train of differential equations to hammer at the new problem and make a new path for the practical man to follow.

Prof. Benj. F. Bailey in the articles of this and last week on "The Induction Coil" sets out the technology of the spark coil, a device which is in very extensive use, and yet concerning which practical men know comparatively little from a quantitative standpoint. There are very few men engaged in the business of manufacturing and supplying spark coils who have any reasonably precise knowledge of the efficiency of their coils under working conditions, or of how that efficiency is affected by changes in the parts of the system. They know in a general way whether the apparatus is reliable, and in a measure they have a keen practical experience of the effect of changing the parts in certain ways upon the cost and upon the reliability. Nevertheless, if these men were acquainted with the working theory of these devices they would be able to design them more efficiently with a greater degree of expectation and with a lesser degree of anxiety for the outcome. The importance of these articles is not merely in the simplifications of the underlying theory, but in the direct application of the simplified theory to actual oscillographic records.

### THE FIRST SUBMARINE CABLE WITH PUPIN COILS.

It is announced that a new telephone cable is shortly to be laid by Siemens Brothers, of London, across the English channel, from near Dover to Cape Gris Nez in France. This cable is expected to have a length of 21 nauts, and it will contain four insulated copper wires forming two telephone circuits. Each pair will have a linear conductor-resistance of 12.5 ohms per loop-mile and a linear capacity of 0.12 microfarad per loop-mile. The cable is remarkable in that it will have load coils inserted at every nautical mile. That is, a little cylindrical toroid inductance coil, with an iron wire core, is to be inserted in each pair of conductors, and two such inductance coils, end to end, form a lump in the cable at each nautical mile. The resistance of the loop will thereby be increased, but an inductance of 0.1 henry per naut will be added. The mechanical difficulties in the way of inserting these coils, watertight and well insulated, into the cable, so as to stand the stresses of laying, hooking and repairing, are very considerable. It is to be hoped that they will have been safely overcome. The engineers expect to be able to talk over this cable between Paris and Glasgow.

### A COAL STRIKE GAME.

The recent shut-down of the bituminous coal mines in the Central States because of a strike which was heralded loudly for many weeks in advance has doubtless resulted in heavy extra fuel bills for many central stations, as well as other consumers. The supposed necessity of accumulating a big reserve of coal in advance of the shutting down of the mines, and the eagerness of large consumers to get this coal, resulted, of course, in pushing coal prices up to fancy figures. Large consumers, such as central stations, desiring to get more than the ordinary amount of coal per day called for by their contracts, were obliged to pay about double the usual price at the mine in order to secure the extra quantity. There is a strong suspicion in the minds of many coal users that the coal strike is about as serious as an opera bouffe, so far as the coal operators and miners are concerned. A coal mine is something like a central station in that it can be operated at best economy when at nearly maximum output. If a central station could be operated at nearly full load for 10 months of the year and shut down completely for two months, the operating cost per kw-hour would be considerably reduced, although, of course, the fixed interest charges would remain the same. Likewise in a coal mine, if the operators can mine coal at a maximum rate for some months and get strike-scarce prices for a portion of its output, it is a situation to be hailed (by them) with joy. A recent visit to a large coal field in the Central States did not disclose any operators in tears; in fact, quite the contrary. Nor did the miners take the strike question very seriously. In

fact, no great differences or real causes for a strike were apparent. Putting all of these things together only confirms the central-station man's suspicion that he has been worked by the coal operators in collusion with the miners' union officials to pay fancy prices for a big pile of stored coal, the heating value of which is certainly not improving as it stands out in the weather. The wise central-station man can check this game if he will, as land on which to store coal is cheap and reserves can be piled up at times of low prices and kept for long periods, as is now the practice of some of the very large companies.

## CONFUSION AS TO "LOAD FACTOR."

The standardization rules of the American Institute of Electrical Engineers define the load factor of a machine, plant or system as the ratio of the average power to the maximum power during a certain period of time. This would seem to be plain enough, but as a matter of fact among many central-station men all sorts of confusion exists on the subject. Some figure the load factor as the ratio of the average to the connected load when considering a motor load. This, however, is a demand factor, not a load factor. Others figure the load factor as the ratio of the average load to the maximum capacity of the machinery of a power plant, but this is a station factor and not a load factor. Still others figure the load factor for a month by taking the average load only 8, 10 or 12 hours per day, instead of figuring the average for 24 hours, as should be done under the standard rules. In fact, there is a considerable amount of published information giving load factors on different kinds of motor loads, which is not really monthly load factor at all, but a load factor figured for 8 or 10 hours per day. If load factor figures are to be of any value for comparative purposes, they must be figured on a uniform basis, using the total number of hours in the period under consideration.

The chance for misunderstanding when talking of load factor is so great that some engineers now consistently avoid referring to load factor in per cent, but express it in another form, namely, the equivalent number of hours' use of the maximum demand for any given period. When stated in this way there can be no misunderstanding. For example, on a certain large central-station system the yearly output is equivalent to 2800 hours' use per year of the maximum demand on the system. This figure is, of course, determined easily by dividing the kw-hours output for the year by the maximum demand in kilowats. If one wishes to obtain the load factor in per cent as defined by the A. I. E. E. rules, it is only necessary to determine the ratio which 2800 hours bears to the 8760 hours in a year, which, in the case under consideration, gives a load factor of about 31 per cent.

## MAGNETIC PROPERTIES OF MATERIALS.

We print this week an abstract of a paper recently read by Prof. A. A. Knowlton before the American Association for the Advancement of Science, which sums up our knowledge to date on the fundamental nature of magnetism. Up to within the last decade, the trend of acquired knowledge as to the nature of magnetism was toward the belief that magnetomotive force was the inherent property of the atoms of certain elementary substances. An atom of iron, of nickel, or of cobalt, was inherently endowed with m.m.f., while atoms of other substances were either totally or substantially devoid of m.m.f. Moreover, it was supposed that no aggregation of non-magnetic atoms could possess inherent structural m.m.f. During the last decade our views on this subject have been profoundly modified by the discovery of the Heusler alloys. Thus, it has been found that an alloy of three essentially non-magnetic elements —manganese, aluminum and copper—compares favorably in ferro-magnetic properties with cast iron. Evidently, unless the internal activities of an atom of one substance are markedly changed by the proximity of an atom of another substance, the existence of a structural m.m.f. in a mass of metal is dependent upon a certain aggregation of molecules, and not necessarily upon the inherent properties of the atoms or the molecules in segregation.

The only peculiarity from this point of view of the magnetic elements iron, nickel and cobalt is that their molecules are so constituted that, when associated together in a mass, a magnetic aggregation is produced; whereas, the molecules of a non-magnetic element require to be associated with other kinds of molecules in order to co-operate into the formation of a magnetic aggregation. On the other hand, when dynamo iron is magnetically improved by the addition of non-magnetic substances to the melting-pot it is doubtful whether any Heusler effect is thereby produced. In the first place, beneficial results are only found to follow the adulteration when the quantity of non-magnetic material is comparatively small. There is no longer a gain, but a decided loss, if the added material exceeds a certain small percentage of the iron contents. In fact, when aluminum is added in this way, the finished product, on analysis, frequently shows very little residual aluminum in the mass, although the magnetic behavior of the mass may be superior to that which would have been obtained in the absence of aluminum in the preparation. In such cases the belief is warranted either that the added non-magnetic ingredient combines with other impurities and disappears with them in the form of slag and gas, or that the added non-magnetic ingredient acts as a solvent which fosters a certain type of crystallization in the mass of dissolved iron.

As pointed out by Professor Knowlton, there are certain very suggestive recent observations that offer clues to this wonderful labyrinth of magnetic phenomena in metals. These are the æolotropic magnetic behavior of prothotine, or its different magnetic susceptibility along different directions, and the apparent absence of the Kerr effect in Heusler alloys. That is, polarized light falling on a polished surface of iron is reflected circularly polarized when the iron is magnetized, but not so from Heusler alloys. It is along such cleavage lines between series of allied phenomena that investigation may be able to make the most rapid progress. Underlying all of these questions concerning the interrelations of magnetism and matter is the fundamental riddle as to the nature of magnetism itself in free space, or away from ordinary material substances. This basic question as to what kind of disturbance in the universal ether produces or associates with magnetic flux remains as much in the dark as ever. But it is quite within the province of expectation that at any time physical investigation may throw light on this inquiry. There is strong probability that if we can gain an insight into the mechanism of magnetic flux we shall at once gain a corresponding insight into the mechanism of electric flux, as the relations of these fluxes to each other and to energy are well known.

## Central-Station Statistics.

The April issue of *The McGraw Electrical Directory* contains reports of 210 central-station companies not previously listed. The total number of companies reported is 6055, 5550 of these being in the United States. The previous issue (October, 1909) reported 5908 companies, there thus being a net gain of 147 companies, with 63 dropped out through consolidation or other cause. The total number of companies added in the past year is 431. Of the 6055 companies reported, 3454 report that they carry electrical supplies, 4414 supply alternating current and 1650 supply direct current, the number of the latter decreasing yearly. Companies to the number of 154 do a purely transmission business, 300 combine railway with lighting, while 392 do lighting and sell some power in bulk. Nebraska shows the largest gain, with 13 new companies; New York comes next, with 12, Washington with 11, and Pennsylvania follows, with 10. The Dealers and Contractors' Section contains 6191 names of dealers, contractors and jobbers, not including the central stations carrying supplies.

## Electric Railway Debates at Cornell.

In order to develop among the students a judicial point of view toward electric railway problems, Professor Norris, of the department of electrical engineering at Cornell University, has arranged a series of six debates as a part of the term's work in electric railways.

The members of the class have been divided into a number of debating teams, each of which is scheduled to present the affirmative or negative side of an assigned topic for discussion. The topics selected relate to the advantages of the steam locomotive for long hauls, the economy of electrifying trunk-line terminals, the characteristics of the repulsion and the single-phase series motors for general traction, the experience of the New York, New Haven & Hartford Railroad Company with single-phase traction, the Cleveland 3-cent fare, and the commission control of electric railways.

These debates are considered to serve a number of valuable purposes: They relieve the monotony of the technical work of the course. The men are stimulated to investigate live topics, and thus relate their technical knowledge to practical operating conditions. The debates teach the students to condense material into a small compass, because the time allowed is limited. The practice gained in extemporaneous speaking, in which engineers are usually weak, prepares the men to take active part in association work, etc. Debates of this kind also teach the young engineer self-reliance, because the men have to champion and defend the ideas they present; they thus develop so-called engineering conviction.

## Ohio Independent Telephone Situation.

Friends of the Elson telephone merger bill succeeded in securing postponement of action upon the measure in the Ohio Senate on April 13, when it came up a day ahead of its scheduled time. This was done because the full force in its favor was not present and it would probably have failed. The date set for the consideration of the bill is Tuesday of this week.

It is said that the investigation of the vote and the work of the lobby in the House of Representatives, following action on the Elson bill, will result in the State placing employees of the General Assembly in charge of the telephone rooms hereafter instead of allowing employees of the companies to care for them. This investigation is stated to have developed the character of the work done where bills are favorable or objectionable to certain interests, and an attempt will be made to prevent a repetition in the future.

Reports are now being received from the engineers and managers of all the properties controlled by J. P. Morgan & Company at the offices of F. A. Davis, at Columbus, showing the amount of new work and improvements needed to bring them up to first-class condition. As soon as Mr. Davis approves these estimates, the funds will be furnished by the New York house and the contracts will be made.

Clarence Brown, formerly attorney for the United States and Cuyahoga Telephone Companies, has filed an answer in the courts at Cleveland to the suit brought by Samuel J. Schwerr against the United States Telephone Company, denying that Schwerr brought the suit in his own behalf. He alleges that it was brought on behalf of certain parties who have no interest in and are not owners of the voting trust certificates. He claims that the suit is the result of an alleged agreement between Schwerr and these parties, by which they use his name to bring suit which they cannot maintain in their own name. He denies that any fraud has been committed on the part of his co-defendants or any one else with reference to the sale of stock or the performance of his duty as voting trustee.

Attorney H. B. McGraw, acting for the independents, says that the answer does not bother his clients. He says that he has never made any secret that the suit is backed by the National Independent Telephone Association, and that the attorneys were employed by that organization. He says the suit is perfectly proper, and that the answer will have no effect upon it.

## The Status of the Engineer.

In an address delivered at the Clarkson School of Technology, Potsdam, N. Y., on Founders' Day, March 18, Dr. Charles Proteus Steinmetz said that engineers are too much inclined to consider only the engineering side of life and to lose sight entirely of the relations with the world at large. For engineering to be recognized as the central stay on which civilization depends, engineers must be interested in something more than mere engineering as a life work. To consider engineering alone, and care for nothing else, is fatal to individual development. It has been said that the greatest success of an engineer is usually achieved not in engineering alone, but in other things. To be successful and recognized as an engineer, one should do things outside of engineering.

"Oftentimes, the most successful engineering graduates are those who, when they leave college, really have the least practical knowledge. If in college you devote too much time to gain practical knowledge and experience—which is far better acquired afterwards—you miss the time required to gain the theoretical knowledge, the understanding of the fundamental principles, which you can never acquire afterwards. You must not think that when you graduate you are a full-fledged engineer; it is then that the time of learning really begins—that is, on commencement day.

"To those of you who are electrical engineers, the most effective way of learning is in the testing room of a large manufacturing company. You can there, in a shorter time, get more practical experience than anywhere else in the industrial and engineering world.

"When you graduate you will find that the method of learning has changed. When in the technical school, the instructor takes the responsibility of your understanding things; when you get out, it is up to you to teach yourself. It rests with you altogether. No one will offer to help you."

## Maryland Public Utilities Commission.

Governor Crothers, of Maryland, has not announced appointments to the public service commission recently authorized by the Legislature. It is reported, however, that the chairman of the commission will be Mr. Joseph D. Baker, who has large business interests in Frederick. There is also a rumor that Col. Sherlock Swann, the president of the Police Board, will be a member of the commission. Attorney-General Isaac Lobe Straus, who drafted the bill, has been tendered a place on the commission, but he has refused.

There has been considerable discussion concerning the clause in the bill relating to the eligibility of members, which provides that "no person shall be eligible for appointment as, or hold the office of, commissioner who holds any official relation to any public service corporation subject to this act or who owns stock or bonds therein." Attorney-General Straus, who at the request of Governor Crothers made a statement as to this clause, said

that the only requisite for any prospective appointee of the commission is that he shall dispose of such stock or bonds as he might hold in corporations that are affected by the law. "This provision was taken from the New York law, where it is now operated. I was somewhat doubtful about its wisdom, and brought it especially before the Cabinet for consideration. After discussion of the subject pro and con at two successive meetings, it was decided to retain the provision in the draft of the law. I also brought the clause specifically to the attention of the judiciary committee of the House of Delegates, which made no change in it. While there are some objections to the clause, I think that it will work well and will not at all prevent the selection of the sort of commission the Governor has in mind, which, it is needless to say, is the best sort. If any person selected by the Governor for appointment owns any of the securities referred to, he could easily dispose of them if he were willing to accept an appointment on the commission and undertake its work. A commissioner who has no securities in a public service corporation whose rates or services are in question before the commission would be relieved of much possible embarrassment in disposing of the case. He would feel completely assured that no one at all in the community could possibly imagine that his decision, whatever it might be, was influenced by any other consideration than the right and wisdom of the matter in dispute. While there is, of course, room for difference of opinion on the point, I think that, upon the whole, it is decidedly better that the provision is in the law."

Governor Crothers proposes to make a trip to New York in order to make a personal investigation of the public service commissions of that State. He may appoint the three members of the commission first and invite them to make the trip with him.

## Compass Errors on Steel-Hull Ore-Carrying Vessels.

The United States hydrographic office at Chicago has recently undertaken the instruction of lake pilots and mariners in the use of the pelorus for checking the indications of their compasses, and in this way is rendering a service of much importance to lake navigation.

As a result of the magnetic character of the construction and loading of some of the large steel-hull iron-ore carriers on the Great Lakes, the compasses of these vessels undergo considerable variations. In some instances these errors reach a magnitude of half a point, or about six degrees, a deflection from the true indication which would be quite serious in directing the course of a vessel were its presence and value not detectible before mischief resulted.

As a check upon their compass indications, all the large ore ships of the steel corporations carry some form of pelorus, an instrument for reading the true bearing of the sun with relation to the geographical or the magnetic meridian. This device, in one form, comprises a mariner's-compass card mounted on gimbals, and provided with a sight or a wire gnomen which casts a beam or shadow from the sun onto a divided circle. The reading of this circle, when interpreted from tables which give the sun's bearing for each minute and hour of every day in the year, enables the true north-and-south line, or the magnetic meridian if the local variation is definitely known, to be ascertained with accuracy.

On the large steel-ore carriers, such a determination is made at least once each voyage, as the magnetic error of the ship does not long remain constant. The quality of the error is found to vary not only with the natural magnetism of the hull, but with the direction of the ship's keel when being loaded with ore. A shift in the cargo or rearrangement of the ore in the hold also varies the compass error, as might be expected. A certain temporary component of this error gradually disappears, however, making the task of correcting for the variation unusually difficult in vessels of this class. As the result of the foregoing diversions of the compass needle, its indications must be frequently checked by comparison with the true meridian as shown by a solar observation with the pelorus.

The effects of the ship's permanent magnetism, which remains in the steel hull as the result of earth magnetization assisted by hammer blows during construction, are "killed" as far as possible by the adjustment of steel bar magnets near the compass, these being so disposed as to counteract the field of the vessel. During construction a steel ship usually becomes magnetized in the direction in which the earth's lines of force traverse its members. Thus, this magnetization does not necessarily take place parallel to the keel, in many instances being in a direction considerably athwartship. By the adjustment of the compensating magnets, the ship's magnetism can be completely "killed" for a given latitude, but corrections must be applied for other positions as well as for the magnetic variation which takes place with time, in the ship's structure. The compensating magnets are usually mounted within the binnacle pedestal, directly beneath the compass needle, being carried on screw-thread adjustments which enable their corrective position to be set with nicety. All electrical wiring and sources of magnetic flux are kept as far as possible from the compass, except in the case of the binnacle lamp itself, to supply which a twisted-pair conductor is used, the lamp loop being set at the extreme distance above the compass card allowed by the binnacle structure.

## Ilgner British Patent on Electrically Driven Reversible Rolling Mills Declared Invalid.

An English court has rendered an opinion declaring invalid a patent granted in 1902 to Carl Ilgner on a method involving the application of a flywheel to an electric power system for driving rolling mills. The decision was in a case alleging infringement, and the defense was lack of invention, it being claimed that the system was merely an obvious application of the Ward Leonard system involving the use of a motor-generator intermediate between a main generator and the final motor.

The court in delivering its judgment, after reciting the general state of the art prior to the invention of the Ward Leonard system said that in 1891 Mr. Ward Leonard devised a method of overcoming the difficulties enumerated by introducing between the dynamo and the motor which drove the machinery an intermediate motor driving an intermediate dynamo and controlling the strength of the field of the intermediate instead of the field of the principal dynamo, the field of the motor being also separately excited and remaining a constant field. "The Ward Leonard system, both in its simpler form and in the form which involves the introduction of an intermediate motor and dynamo, was fully described in letters patent 14,509 of 1891, and had long before 1902 been the subject of much discussion among electrical engineers, both in this country and abroad, especially with reference to cases of variable loads on the working motor entailing variable demands on a source of supply which was used for more than one purpose. The Ward Leonard system in both its forms had by 1902 become part of the ordinary stock in trade of the electrical engineer, subject, of course, to existing patent rights, to apply it to the control of motors used for any purpose whatever, including the running of reversible rolling mills."

The specification as a whole (Ilgner's), though clumsily framed, might, he thought, fairly be construed to direct that in working reversible rolling mills electrically, one was to adopt the full Ward Leonard system for the sake of economy and put a flywheel on the intermediate dynamo in order that any extra demand required to be made on the source of supply might be made gradually, only the extra power required being meantime supplied by the flywheel. The court held that the essential feature of the invention lay in the idea of "putting a flywheel on the intermediate motor of the Ward Leonard system of control, as applied to reversible rolling mills, the only practical direction for carrying the idea into effect being the direction as to the motor of such dynamo being so constructed as to slow up with an increased load, which was an obvious necessity if the flywheel was to act at all. It was

that Ward Leonard idea of the introduction of an intermediate motor and dynamo which rendered possible the use of a flywheel in connection with motors with reversible loads and driven with power supplied from a central station."

The court was inclined to think, however, that the real reason why reversible rolling mills were never run electrically till a date some time after Ilgner's patent was because motors strong enough and electric plants big enough for the purpose had not been brought to the requisite state of perfection. "As soon as electric motors and electric plants had reached that state of perfection which admitted of their application to and use for machinery requiring such enormous horse-power as a rolling mill, it appeared to him that any competent engineer would, without aid from Ilgner, see:

"(1) That the only practicable system of control was the Ward Leonard system; and (2) that having regard to the nature of the load, a flywheel was desirable; the difficulty of using a flywheel in the case of reversible loads when the current was supplied from a central station being got over by the interposition of Ward Leonard's intermediate motor and dynamo."

The conclusion of the court was that the Ilgner patent is invalid for want of subject-matter and that the claim of infringement therefore fell.

## New York Section of the Illuminating Engineering Society.

In a paper presented at a meeting of the New York Section of the Illuminating Engineering Society, held on April 14, Mr. Bassett Jones, Jr., gave a mathematical demonstration of the light flux distribution obtained from surface sources of limited size. The equations derived have been used by the author in calculating the flux distribution produced by incandescent lamps placed behind glass plates and so arranged that each plate acts as a surface source of light.

Messrs. L. R. Hopton and H. E. Watkins presented a paper entitled "The Relation of Fixture Design to Modern Illuminating Engineering Practice," in which was given much interesting information relating to the historical development of the decorative art as illustrated by the arrangements of lighting units at various periods. The authors showed how the development of the various appliances for lighting, such as the lamp, the torch, the candle, the oil lamp of colonial times, and finally the modern electric lamp has been followed by a development in artistic treatment of the appliances. They stated that governed by architects' individual treatment of the period of architecture from which he gathered his inspiration, the illuminating engineer working with the fixture designer may produce lighting fixtures that will display the same skill in utilizing the latest modern appliances and thereby attaining the same economy in the construction of the fixture as has been shown in the use of modern construction of steel and iron in connection with a period of architecture that at its first development made use of entirely different means and materials for its structures.

## Telephone Report to Massachusetts Highway Commission.

As a result of investigations extending throughout the past two years, Messrs. D. C. and W. B. Jackson, of Boston and Chicago, have submitted to the Massachusetts Highway Commission an exhaustive report of over 40 pages upon the rates of the New England Telephone & Telegraph Company, with particular reference to the Boston & Suburban division. Reference has already been made in these columns to the complete appraisal of the company's property which was made by these engineers at the request of the commission about a year ago. The present report follows a most thorough study of the traffic and operating conditions in the company's territory, and is, together with the appraisal, probably the most detailed analysis ever made of telephone rates in an urban area of such scope. The outcome of the investigation is a recommendation by the engineers that sweeping reductions and changes be inaugurated in the Boston & Suburban division of the company's service, involving a lowering of toll rates between the center of Boston and suburban communities not over 7.5 miles distant, substantial reductions in the existing metropolitan exchange rates and the establishment of a zone system of charging.

The fundamental changes recommended in the district rates are ascertained by dividing the territory into exchange districts in which rates in general much lower than the present charges will apply, but with the provision that toll charges shall be made for all service outside these local districts. In this way the engineers have determined that the business of the small telephone user can be secured and the costs of service more equitably distributed than under the present system of charges. This subdivision is planned to meet the needs of the great body of average users rather than the special desires of a few large users or the extraordinary requirements of others. Subscribers in the present metropolitan area will no longer be compelled to pay for suburban service unless they have use for it, and then only in proportion to their requirements.

## Electrical Engineering Education.

The meeting of the American Institute of Electrical Engineers, held in New York on April 15, was devoted to the presentation and discussion of a paper by Dr. Samuel Sheldon entitled "Education for Leadership in Electrical Engineering." The author based his statements upon statistical data relating to men recognized as leaders along worthy lines of efforts and gave the characteristics of electrical engineering leaders. He considered the educational advantages enjoyed by these leaders formulated those essential characteristics of leaders which can be imparted to the individual by educational processes, and discussed some of the problems encountered by educators in carrying on these processes.

The author based his analysis on the training and characteristics of the 98 members and 32 associates of the American Institute of Electrical Engineers, whose names appear in the 1907 edition of "Who's Who in America." Of the 98 members 19 are without college degrees, 39 have bachelor degrees, 45 engineering degrees, 21 masters' degrees and 35 doctors' degrees. Two of the members hold five degrees, four hold four, 10 hold three, 21 two, and 42 one. Of the members without degrees, 11 had the advantages of college instruction, but did not graduate, and 14 of the holders of one degree pursued postgraduate studies without receiving a second degree. The percentage of members holding college degrees is 80.6 and of those who have had college instruction is 90.0. The average age of the electrical engineer is 46.2 years, while that of the civil engineer is 57.5 years, and of all those whose ages are given in "Who's Who," 53.3 years. The electrical engineers are, therefore, too young as yet to be properly judged as to their achievements. Inasmuch as the greater number of students are graduated from college at the age of 22.5 years, the average of the notable engineers who are the subject of this study were graduated from college in 1883.

Basing his conclusion upon an analysis of the characteristics of the recognized leaders, the author said that, other things being equal, the engineer who can speak effectively, as well as write, is the engineer who will exert the widest influence. Skill in the oral presentation of a plan, in the defence of a position, in the advocacy of a reform, or even in the making of a graceful and apposite response to a toast, has largely contributed to many a man's success. It is especially desirable for those who hope to occupy positions of executive responsibility.

A more discriminative system of selection of entering students would undoubtedly decrease the number of students and increase their average age. Of course, a better resulting quality of product would be expected after four years. The great advantage to be obtained, however, by this discrimination, is the elimination of students of harmful influence, whose charac-

ters and circumstances militate against earnestness in endeavor and discipline of desire.

DISCUSSION.

Dr. Charles S. Howe expressed the opinion that it is of greater importance to teach a student where to find the records of facts than to teach him the facts themselves. The student should be so trained that when he is confronted with any problem he will know practically just where to find the proper information on the subject. Special effort should be exerted to teach the student to think for himself. It is probable that the best solution of the teaching problem will be a broadening of the courses of study together with an increase in the years of study from four to five for graduation.

Dr. Abraham Flexner discussed the relation of cultural to vocational studies. He claimed that the distinction between culture and vocation is a matter of convenience. Culture means merely the fuller exploration of vocational and instrumental means. It is nothing but an historical accident that the untechnical treatment of literature and artistic subject has come to be specifically known as culture. Four years do not suffice to produce a highly specialized engineer, with cultural outlook besides. Perhaps the lines of the technical school may have to be laid down more broadly, on the assumption that a subsequent apprenticeship may shape the young graduate to his definite practical use.

Mr. J. W. Lieb stated that, in his opinion, the technical-school graduate has not been sufficiently well grounded in the power of expressing and of presenting his conclusions. He expressed the hope that the technical schools will rise to the opportunity of conferring upon their students a more thorough recognition of the value of a broad basis for culture.

Prof. D. C. Jackson remarked that he does not sympathize with the proposition of making a five-year or six-year college course, or requiring an arts degree as a part of the entrance requirement to the engineering school. He said that a continuous course of four years, if not of five years, in a single unitary direction, with a single unitary purpose, will bring far better results as an educational proposition.

Dr. A. E. Kennelly claimed that the qualifications which are competent to bring men to leadership are also qualifications that lead men to follow; that men, before leading, must be able to follow, and that the requirements of the man who shall follow are discipline and faithfulness and earnestness in whatever he undertakes. The qualities for following depend largely upon the cultivation of ideals. The study of ideals is of the greatest importance, so that anything done may be performed with the best of one's ability.

Dr. Wm. McClellan expressed the opinion that all technical degrees should be abolished as a first course. It is preferable for a student to be given a thorough knowledge of physics, chemistry and mathematics than of the engineering side of these subjects.

In closing the discussion, Dr. Sheldon called attention to the fact that nearly one-third of the entering freshmen should never have come to the technical school on account of their lack of natural ability. The examinations should be so conducted as to determine whether or not the proper natural traits are present in the candidate for admission.

## Relation of Electricity to the National Fire Waste.

Mr. W. H. Merrill, manager of the Underwriters' Laboratories, Inc., of Chicago, made an able speech at the weekly meeting of the Electric Club in that city on April 13. His subject was, "The Relation of Electricity to the National Fire Waste." In introducing him, President F. P. Vose mentioned the interesting fact that the building of the Underwriters' Laboratories in Chicago is probably the only absolutely fireproof building in the city. Even the office desk and the filing cabinets are of steel, and there is no wood trim and practically nothing to burn.

Referring more particularly to the design and installation of electric appliances, Mr. Merrill expressed himself as having no sympathy with extremists. Legitimate safeguards are what are needed. He had no particular sympathy, for instance, with an insurance inspector who requested at a recent meeting of one of the associations that snap switches should be designed in such a way that it would be impossible to use them on series-arc circuits. So long, he said, as it is necessary to use heating effects to secure illumination, just so long will there be fire-hazard problems in connection with installations of whatever character used to produce artificial illumination. The incandescent electric lamp is probably the best lamp known so far as the fire risk is concerned; it does radiate some heat, but it is obvious that a closed lamp is greatly superior to an open flame.

Fire-signaling systems are almost all electrical, but, in Mr. Merrill's opinion, the engineering skill shown in devising and maintaining electrical appliances for fire prevention has not kept pace with the brains and ingenuity displayed by electrical engineers in the design and application of electric light and power apparatus. The improvement in the one is much less marked than in the other. Electrical engineers have not given sufficient consideration, perhaps, to improving electric fire alarms. For recent advance in this art we must look to the other side of the water, particularly to England. The insurance people in this country, in considering means of fire prevention, do not come in contact with the more highly trained minds among the electrical engineers. There is a field here for American electrical engineers that is practically unlimited. Let engineers take up fire signaling and make it parallel to electric light and power work. As it is now there are not infrequent instances of automatic protective apparatus that fails to "automat" at the critical moment.

The speaker had nothing but praise for the methods developed for the safeguarding of electric light and power apparatus in relation to the fire hazard. The National Electrical Code is now practically the Bible of electrical constructors and contractors. In devising the Code the intent is to get the one best opinion of all concerned on any given proposition. This is a broad policy, but it has been adhered to consistently in preparing the rules and regulations of the Code.

The fire waste due to electricity can be estimated at anywhere from 5 per cent to 25 per cent, depending on the point of view or state of mind of the investigator. Often fires are attributed to electricity when the real cause is unknown. Fire chiefs and fire patrolmen sometimes attribute fires to electricity as an easy way to avoid the used of the undesirable word "unknown" in reporting on the cause of fires. Sometimes, indeed, the fire is attributed to electricity when there are no electric wires of any sort in the building. The speaker believes that the actual proportion of the total fire waste due to electricity is from 5 per cent to 10 per cent. This is a comparatively small proportion, but because something else is worse electricity is not to be excused for the number of fires that it does cause. It must be remembered that the applications of electricity are constantly increasing in size, number and variety. Therefore, it is necessary to devise constantly new devices to safeguard these new electric appliances against danger of fire.

Elaborating on this idea a little, Mr. Merrill declared that electric heating devices have caused a considerable number of fires in fine houses; furthermore, it is to be considered whether the use of electrically operated vacuum cleaners may not contribute to the fire hazard by overloading circuits. In a word, it is imperative that all electric apparatus should be safeguarded to an even greater extent in the future than has been done in the past, excellent as has been the work accomplished in this direction. There are many agencies co-operating to this end, and it should be the duty and privilege of all electrical men to help, in their individual capacities, the beneficent work of these various organizations.

Mr. D. L. Gaskill, of Greenville, Ohio, secretary of the Ohio Electric Light Association, was present as a guest, and on being called on by Mr. Vose extended greetings from Ohio. He invited all present to attend the Ohio convention at Cedar Point in July. Mr. Gaskill remarked that electric wiring formed a convenient scapegoat for fire-insurance men in assigning the cause of fires. He told of several instances where

electricity had been blamed for fires when there were either no wires where the fire started or else the fires started at a time when the wires were not carrying electricity. Speaking more generally, Mr. Gaskill predicted that within 25 years from now all wheels in Chicago will be turned by electricity and all food will be cooked by means of electric heat. "We are in a good business," he said; "it will pay us to stick to it."

Mr. J. T. Caldwell, an insurance man who was present as a guest was called on. He spoke briefly, saying that in his experience 50 per cent or more of fires are due to unknown causes. It is suspected that the percentage of incendiary fires is much larger than is generally supposed. Mr. A. A. Gray pointed out that owners and architects of buildings should demand the best class of electrical construction and see that the electrical contractor receives a fair price for doing work of this character so that he would not be tempted to skimp the work. The men engaged in the other departments of electrical activity should uphold the hands of the electrical contractor, insisting that the standard of electric construction shall be high, the contractor to receive a fair price for first-class work complying with Code requirements.

## Plans for Lighting a Small Store.

The Chicago Section of the Illuminating Engineering Society met at the rooms of the Western Society of Engineers on the evening of April 14 to consider plans submitted by various members for the lighting of a small store according to specifications sent out in advance to the various members. This store was 30 ft. wide, 100 ft. deep, with two show windows of the enclosed ceiling type 8 ft. deep by 8 ft. high, 10 ft. front each. The specifications called for an average illumination at the plane of the counters of 3 foot-candles. Eight plans were presented covering a wide range of treatments.

Mr. J. G. Henninger, of the National Electric Lamp Association, engineering department, presented a plan for lighting the store with tungsten lamps using 16 outlets arranged in two rows, one row being over each counter. At each outlet he specified one 100-watt bowl frosted Mazda lamp with a holophane intensive reflector. Deducting the space taken by the shelving, which was 3 ft. along each side, the watts per square foot were 0.72, the total watts being 1600. For the windows he specified four 100-watt bowl frosted lamps along each of the front panes in a distance of 10 front feet for each window, and in addition three 60-watt lamps along the slant side of the window leading to the center front-door entrance. On these he proposed to use focusing-holophane reflectors, every other unit being tipped 15 deg. away from the glass and every other 40 deg. away from the glass. This would give the wide distribution called for by such a window.

Mr. George C. Keech, of the Cooper-Hewitt Electric Company, presented a plan employing hemispheres enclosing a tungsten lamp combined with a circular Cooper-Hewitt mercury-vapor tube lamp. The tungsten lamps act as ballast for the mercury-vapor arc and also to correct its deficiency in color. He proposed 10 units with a consumption of 0.8 watt per square foot, leaving the space occupied by shelving out of account. Each unit consumed 225 watts, the total wattage for the store interior being 2250.

Mr. J. C. Brattan, of the Peoples' Gas Light & Coke Company, proposed the use of 14 three-light inverted gas chandeliers with prismatic reflectors. The outlets were arranged in two rows; the total number of burners was 42. He figured the average foot-candles as four instead of three, as in the specifications. He assumed the mean lower hemispherical candlepower of each burner with reflectors to be 80.

Mr. A. C. Murray, North Shore Gas Company, submitted plans for lighting the store with gas using four four-light inverted gas burner fixtures with prismatic reflectors, arranged in a row of central outlets along the center line of the ceiling. The difference between Mr. Murray's proposition of using 16 inverted burners to obtain three foot-candles as against Mr. Bratten's proposition to use 42 inverted burners with four foot-candles was commented upon.

Mr. Harry B. Wheeler, of the engineering department of the National X-Ray Reflector Company, presented plans for lighting with tungsten lamps by the indirect system, obtaining illumination by reflection from the light-colored ceiling. He divided the floor into four equal rectangles 23 ft. x 24 ft. and used four outlets, one in the center of each rectangle. At each outlet he specified seven 100-watt tungsten lamps, making a total of 2800 watts for the store. The watts per square foot, omitting the shelving space, were 1.27. In his calculations he assumed 0.41 watts per lumen (watts per square foot to produce one foot-candle). For practical purposes he said that three foot-candles with indirect lighting would give better practical results than the same amount with direct lighting, because of the effect of the exposed lamps in direct lighting, which exposed lamps contract the pupils of the eyes. For each window he specified six scoop reflectors with 60-watt tungsten lamps in each.

Mr. H. D. Howe, of the Holophane Company, suggested an arrangement of outlets practicable for either gas or electricity. He placed two rows of eight lamps in the store, one row being over each counter. If gas were used he suggested a one-light fixture with an inverted gas burner and prismatic reflectors; if electricity were used a 100-watt tungsten lamp with prismatic reflector.

Mr. O. R. Hogue, of the Commonwealth Edison Company, through Mr. J. P. Smith, of that company, submitted a plan on the assumption that a row of outlets already existed in the center line of the ceiling—a condition frequently found in practice. He assumed five such outlets, and suggested four 60-watt lamps on short fixtures at each outlet, the lamps being equipped with extensive type holophane or Alba reflectors. This would require 1200 watts.

In the discussion Mr. A. L. Eustice, of the Nernst Lamp Company, gave a suggestion for lighting the store with Westinghouse Nernst lamps. He figured on the basis of 0.33 watt per lumen.

Mr. J. R. Cravath submitted a plan for consideration which consisted of indirect lighting for the general illumination and shaded direct lighting to add to the illumination along the counter. For the indirect lighting he divided the floor into three equal rectangles with a 500-watt indirect chandelier at the center of each rectangle. Along over the counters at about 15-ft. centers he suggested the use of deep beehive reflectors which would uniformly illuminate an area equal in diameter to about 1.5 times the height of the lamps. These reflectors are opaque with an efficient silver coating and are deep enough to shade the lamp filament from the eye, except when a person is looking up into the reflector. These direct lighting reflectors should be covered with brass spinnings or art-glass bowls, as the bare reflector is not ornamental. The chief objection to the plan he stated to be the appearance of the light coming from the inside of these opaque reflectors.

Mr. Moulton called attention to the undesirability of arranging window-lighting reflectors along the sides of the windows leading to the store entrance, where they are visible from the front. These detract from the effectiveness of the show-window lighting.

Mr. Henninger stated his opinion that the ideal window-lighting has no lamps exposed, thus producing the effects seen on the stage in theaters. He stated as his conclusions after carrying on extensive tests on loss of light due to dust and dirt, that in some downtown districts or cities dust will cause a depreciation of illumination amounting to 70 per cent in from four to six months.

Mr. A. L. Eustice, speaking of the effect of dust, spoke of having made over 1000 tests to get information on this subject under commercial conditions. His conclusions were that a typical installation of tungsten lamps with prismatic reflectors would, under average city conditions, depreciate in effectiveness 10 per cent per month on account of dirt if lamps and glass were not cleaned.

In assuming the operating efficiency of any system the engi-

neer is apt to go far astray unless he takes full account of the surroundings. He had obtained figures all the way from 0.3 watt to 0.73 watt and 0.84 watt per lumen on installations using the same type of equipment, the difference being due to the conditions under which they were installed and operated.

## Street Photometry and School-Room Lighting.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of April 11. Chairman T. H. Piser presided. After the usual business had been transacted, Dr. Louis Bell gave a talk upon "Street Photometry" and Mr. B. B. Hatch read a paper on "Schoolroom Lighting."

### STREET PHOTOMETRY.

Dr. Bell pointed out that photometric work is not easy at its best, as the outstanding errors are of a grade which is large compared with other measurements. It is easy to measure a meter to within 0.001 mm, or a kilogram to within a milligram, while in photometry, even under laboratory conditions, it is practically impossible to come closer than one part in 1000, and in very careful work an accuracy of one part in from 200 to 300 is about the best that can be expected. In photometric work the observer is handicapped by the power of the eye in discriminating between two shades which are nearly, if not quite, alike. On the whole, an accuracy of 1 per cent in the laboratory is good work, assuming fairly similar lamp intensities and more or less training of the eye and experience on the part of the observer. Dr. Bell said that he usually expects to make actual settings to one-half of 1 per cent, using a Lummer-Brodhun photometer in the laboratory, and in very good work to within one-quarter of 1 per cent. About this degree of accuracy can be obtained with a very carefully handled Bunsen photometer.

On the street, the conditions are most unfavorable to scientific precision. The lights are of different colors than the standards, introducing errors of heterochromic photometry; usually no storage-battery lamp is available; a small standard lamp is used, supplied from a battery with voltmeter and ammeter errors to consider, or else a Hefner lamp is used, subject to drafts, vibrations and other adverse conditions. On the street the instrumental errors are at least from two to four times as great as in the laboratory. If one could get within 1 per cent or 2 per cent on the street, however, all would be well, but the instrumental errors are only the beginning of the trouble. The observer is dealing with an inconstant light. The Welsbach lamp has a good reputation for constancy of illumination, but there is no means of determining the gas pressure and the effect of drafts is serious in causing fluctuations. On account of the downward driving of the flame in the inverted Welsbach, the lamp is very sensitive to changes in pressure and draft. The normal candle-power may be varied over a range of from 10 per cent to 20 per cent. Although the accuracy of a photometric measurement in such a case may be within 2 per cent the illumination of the lamp may be 10 cp high at 8:15 p. m. and 20 cp low at 9:30. The light as measured on the street is subject to an error of from 10 per cent to 20 per cent in addition to accidental causes of variation. In measuring an incandescent lamp on the street it is not ordinarily feasible to tell whether the current is a tenth high or low at any time, depending upon the action of the regulator, leakage, etc. With the arc lamp, which is still the backbone of street illumination, there is a shifting of luminous value as the arc goes through the process of burning up to its regulation point. If the period of this could be determined there would still be trouble from the movement of the arc around the electrode, producing variations of from 10 per cent to 20 per cent in candle-power. It is difficult to assign average values to the diverse readings which one gets on the street, and, further, the personal equation of the observer tends to produce a photometric error of positive or negative value. The net result is that the actual errors on the street are likely to be a good many times the photometric and instrumental errors, aside from the question of color. The latter is apt to be somewhat exaggerated in practice. The errors in color photometry are generally made at points where the actual value of the street illumination is too low for consideration.

Dr. Bell stated that in the face of the comparatively large errors due to the inevitable fluctuations of the light and the errors of the observer any attempt at nice evaluation on the street is pretty nearly futile. One can tell whether the lamps are doing their duty, but not precisely what each lamp is doing in absolute candle-power averaged over a considerable period. All attempts to sell light by measurement are handicapped by errors too large for satisfactory results. Dirt on the globes is an important factor in street lighting. It is out of the question to get close results as to the light actually delivered on the street, and any attempt to sell light by street measurements aiming to reach exact values leads inevitably to litigation and disagreement. When a city pays, say $300,000 per year for street lighting a difference of 10 per cent is a considerable matter. The central-station man can, however, sell service with a given type of lamp which can be investigated in the laboratory in extenso. The contract can specify a service of a given number of hours with a certain current consumption or pressure, for a stated type of lamp, maintained in perfect order, and the city can require that a lamp which is normally specified at, say, 100 cp, shall not fall below a certain amount, the latter being sufficient to cover the errors of photometric work on the street. It is easily possible to determine with fairness to all parties whether the city is getting its money's worth and with a known illuminant the photometer will indicate readily whether the limits specified are being passed or not.

In a brief discussion which followed Dr. Bell said that increasing the number of readings made at any given lamp is but a slight aid, since all the lamps in a city cannot be sampled accurately by testing only a few. Prof. W. L. Puffer, Boston, consulting engineer, stated that an incandescent lamp gives the best standard for illumination tests, and said that an illuminometer calibrated before and after reading in the field had been accurate in his hands to from 5 per cent to 10 per cent. Failure to use the instruments properly makes much trouble in this class of work. A frequent source of error is the apparently simple matter of measuring the distance between the lamp and the photometer screen. In the best practice two men work together, one reading the screen and the other the scale. Simple numbering of the scale is desirable, and the use of a long-turning adjustment screw tends to increase the accuracy of the readings. Professor Puffer advised inserting clauses in contracts relating to such matters as current strength, average watts in the lamp, the kind of globes, quality of carbons, retaining a sample, the average candle-power of the lamp under the best possible conditions and the minimum below which it is not permitted to go. The ease of testing incandescent lamps was touched upon, and the possibilities in the way of varying gas pressure mentioned in connection with some Welsbach tests. In a case of this kind the gas makers varied the pressure from 1.5 in. to 3.75 in. water column in the same evening, according to their judgment of whether the engineer making the test had gone home or not. Dr. Bell stated that he found no trouble in using a tungsten incandescent lamp in measuring even a street Welsbach, the error due to color differences being much smaller than the accidental variation due to wind and other disturbing causes. With metallic arcs the feeding period is longer than with the ordinary arc, and the momentary fluctuations are about the same in each case, but the color differences are less important. Dr. C. H. Williams, Boston, emphasized the importance of the personal equation in photometric work, calling attention to the discrepancies which will appear even in the course of laboratory measurements by observers of experience.

### SCHOOLROOM LIGHTING.

Mr. Hatch emphasized the point that only recently have scientific principles in illumination been applied to school-

room work. This work was set in motion by the recent researches of the Massachusetts Board of Education in the subject of defective vision among pupils. The requirements of the schoolroom are radically different from those of the hall or general public auditorium. One is confronted with diverse opinions as to what constitutes good illumination, and should heed the advice of the opthalmologists as to the amount of light necessary for comfortable vision. The opinion of these professional men is better than that of the teaching staff or school authorities.

The number of stations to be illuminated in the schoolroom is large, there being 56 desks in most Boston rooms, although the new standard room has but 42 desks. The stations are fixed in place, and cannot be moved to take advantage of the light as in an office. The desks all face in one direction, and the pupils have to use their eyes for near-by and distant work. In the standard Boston room nine 60-watt tungsten lamps are provided. These are of the bowl frosted type, and it is 10 ft. from the floor to the lower edge of the shade. The room is 26 ft. wide and 29 ft. long, with the teacher's desk at the front and usually a row of windows at the side. The main blackboard occupies the wall opposite the windows. These lamps give an illumination requiring the expenditure of about 0.71 watts per square foot of floor area, and the units are hung in three rows of three lamps each slightly off the center lines of the room running in each direction, and with their axes to the left of the main body of desks facing the teacher. The asymmetrical installation with respect to the axes of the room avoids trouble from shadows, and also tends to provide the illumination shed upon each desk from the forward parts of the room rather than from the rear. The lighting which falls upon the desks from the rear is not considered of any substantial use to the scholars. The light sources are all screened so that in no case is the vision disturbed or dazzled, and no part of the filament can be seen. Some experiments three years ago with indirect lighting gave poor results. The psychological effect of an insufficient amount of illumination was present, and the shadows were lost which were formerly useful in judging distance and relief. Dust gathered so fast on the tops of the glass plates above the lamps that the most active janitor could not keep up with the situation. A deep prismatic glass or opal glass shade is used in the present standard room. The foot-candles are lower, but the soft lighting is better liked than a more brilliant service.

Mr. Hatch stated that a little indirect lighting is practised in some of the drawing rooms used by evening schools. In manual training rooms one fixture is provided to every four benches, with very little cross-lighting. Six outlets are provided in some recitation rooms containing about 700 sq. ft. Cream white is essential on side walls and ceiling for satisfactory indirect arc lighting. Twenty buildings have so far been lighted in Boston by the nine-lamp, 60-watt unit scheme described above, and the endorsement of the authorities and the teaching staff has been secured. The London County Council has favored similar methods. The need is from 2 foot-candles to 3 foot-candles on the nine-lamp system, the Boston authorities setting 2 foot-candles as a minimum. The importance of color treatment was touched upon, and the occurrence of complaints noted when a room which was formerly painted in buff was refurnished in Flemish oak and dark green. Tests showed only 1 per cent difference in the quantity of illumination. There is about 15 per cent more reflection in a light buff finish than in a warm grayish green. The use of reddish pigments should be avoided. Chrome yellow is helpful in ceilings. The Boston authorities have found that the rooms obtain from 10 per cent to 15 per cent more illumination with properly tinted shades as compared with bare windows. The reflection from near-by walls painted white is a serious menace to the eyesight of the pupils, and whenever possible such walls should be tinted, although such a course is only a partial alleviation. Poor lighting at home and the necessity of much more home study than of old is responsible for no small proportion of the difficulties with children's eyesight.

## Convention of the Missouri Electric, Gas, Street Railway & Water Works Association.

The fourth annual convention of the Missouri Electric, Gas, Street Railway and Water-Works Association was held at the Madison Hotel, Jefferson City, Mo., April 14, 15 and 16. The total registration was more than 60, central-station and electrical delegates being in the majority among the operating men.

The first session was called to order Thursday afternoon, April 14, the morning having been taken advantage of by the delegates arriving early to visit the Missouri State penitentiary at Jefferson City, which contains 2200 prisoners, and is the largest single institution of the kind in the world. The electrical visitors inspected the power house and prisoners' quarters, and were the guests of Warden Henry Andrae at lunch, the regular prison fare being served.

With Mr. R. J. Irvine, first vice-president of the association, in the chair, President W. S. Bixby having been detained from the convention, the address of welcome to the delegates was delivered by Mayor Heinrichs, of Jefferson City, in a unique speech, accompanied by the presentation of the city's freedom as symbolized by a big golden key. Following the reading of the minutes of the preceding convention, and the election of a number of new members, the first paper on the program, "The Luminous-Arc Rectifier System," was read by Mr. Louis Friedman, of the Chicago office of the General Electric Company.

Mr. Friedman described the advantages of improved brilliancy and efficiency of the luminous-arc lamp. The maximum intensity being at an angle of about 10 deg. below the horizontal, this type of lamp is particularly well adapted to street lighting. The constant-current rectifier system used with these lamps consists of a specially wound constant-current transformer connected to an oil-immersed mercury-vapor rectifier. This apparatus supplies direct current of constant value to series circuits of magnetite arc lamps, thus deriving the energy directly from the alternating-current lines. According to the speaker, about 50,000 magnetite-arc lamps are now in service in this country, nearly 2000 being in Missouri. The downtown street lighting of St. Louis is one of the most conspicuous examples of this class of lighting.

In the discussion which followed, Mr. C. L. Clary, of Sikeston, Mo., who is also secretary of the association, suggested the use of arc machines driven by synchronous motors for supplying the magnetite lamps in cases where it is desirable to correct the lagging power-factor due to an otherwise inductive load, by operating the synchronous motor overexcited, and so making it take a leading current. This arrangement, he thought, would increase the available generator capacity, coming at the peak of the load; but Mr. Friedman pointed out that the lower efficiency of the motor-generator set, compared with that of the mercury-rectifier outfit, might be expected to neutralize the gain in generator capacity, and, furthermore, this exact relation depends upon a number of conditions, such as the proportion of inductive and non-inductive load, etc., but in general the rectifier set would be cheaper than the motor generator. Mr. H. D. Hibbeler also felt that a motor-generator arc set might better be used to give a balanced load on a polyphase generator, but the point was brought out that two rectifier sets, T-connected, had been employed successfully to accomplish this result. For a non-interconnected two-phase system, Prof. H. B. Shaw, of the Missouri State University, suggested that a single rectifier might be connected across the two phases, having their other ends joined. He also pointed out the fact that the magnetite lamp, like all other arcs, except the familiar carbon arc, supplies its arc material from the negative electrode. Mr. Friedman advised the use of a constant-current rectifier set supplying incandescent and arc lamps in series for the outlying and downtown lighting, respectively, of small towns. This arrangement will require no change in the circuits if shifts in the numbers of the lamps are required later. Mr. P. A. Bertrand pointed out that grounds on the line may introduce static effects which result in the destruction of the recti-

fier tubes, the peculiar mortality of which had been mentioned several times in the discussion. Mr. Herman Spoehrer told of the interesting commercial results of the extensive downtown street lighting with magnetite-arc lamps in that city. A number of merchants just outside the brightly illuminated district have decided that they require similar illumination in front of their stores, and have asked the Union company to extend its arc lines to include their streets. The entire street lighting of St. Louis will shortly be changed over to the magnetite-arc system.

Mr. J. E. Harsh read a valuable paper on the subject of "Securing Profitable Day Load." He explained how the net earnings of any station are largely dependent upon its non-peak load, as well as the uniform character of this demand. Industrial and domestic were the classifications into which the speaker divided the heating loads, which, he said, can be made to form an important part of the off-peak business. He also urged strongly more persistence in going after the small-motor business, and gave examples of this desirable daylight load which are available in any small town without other manufactures than the usual repair shops and stores. More attention, he said, should be paid to the making of special contracts for loads which go off the line at definite hours, as these are good sources of profit to the central station. In closing, he gave a number of practical suggestions for the increase of the day load. The discussion which followed was participated in by Mr. C. L. Clary, Mr. R. J. Irvine, Mr. P. A. Bertrand, Mr. I. D. Cross and Prof. H. B. Shaw. A full abstract of Mr. Harsh's paper and the ensuing discussion will be given in a latter issue.

Thursday evening the members of the association turned out to an enjoyable smoker in the hotel café.

Friday morning the program opened with Mr. Charles S. Lewis' paper on "Condensers for Small Central Stations." Mr. Lewis advocated the greater use of condensing plants by the smaller central stations. He showed a number of examples in which surprising gains have been secured by the addition of condenser equipment, and discussed at some length the principles of design, details of operation for maximum economy, and the practical considerations relative to jet and surface-type condensers with their corresponding vacuum pumps. This paper was illustrated with sketches of the various types of condensers described.

Mr. P. A. Bertrand mentioned a surface-type condenser in which the cooling water is sprayed on the condenser coils, from which it is evaporated by fan draught, the latent heat of evaporation thus rendering a relatively small amount of water sufficient. Mr. C. C. Barnard explained that with a crude condenser system which he has installed a saving of 35 per cent per month in the water bill (at 20 cents per 1000 gal.) is effected, while a 25 per cent decrease in the coal consumption has been noted, although the latter may be partially due to a new engine and improved operating methods. However, the condenser has rendered 25 per cent more engine capacity available. The pumps for this condensing system are maintained at considerable expense, and the city hydrant water, sometimes 80 deg. Fahr. in summer, must be taken through a cooling tower before use. In answer to the question of Mr. P. W. Markham as to whether a condenser could be advantageously installed in a plant where coal costs $1.50 per ton, Mr. P. A. Bertrand declared that since in any case equivalent condenser capacity is cheaper than engine capacity, the former should be considered when augmenting plant. Prof. H. B. Shaw told of a series of practical problems given his students in Missouri State University by which they were asked to obtain the total annual costs of engines of different sizes and types, including all fixed charges, interest, etc., with various prices of coal. The results of all these studies invariably show condensing equipment to be cheaper than all other types, although this consideration does not include cost of attention. Professor Shaw also declared that as the cost of turbine units decreases very rapidly about the 500-kw sizes, this type of machine should receive more attention in the choice of prime movers for small stations.

Mr. N. J. Cunningham, chairman of the committee on accounting and records, discussed the important work before his committee in determining upon the proper handling of the question of depreciation, and in attempting to devise a plan which can be applied by all the companies within the State, in preparing financial statements for the local or State public service commissions, and for the Federal corporation income tax, recently passed by Congress. Companies which do not properly charge off their costs of depreciation, etc., will be required to pay the tax on this amount, besides being subject to local commission scrutiny on account of their apparent earnings, which may be much in excess of the real earnings. Mr. H. Spohrer explained that the Union Electric Light & Power Company, of St. Louis, had until recently set up 10 per cent for depreciation and 2 per cent for amortization of franchise value, but has recently found it necessary to increase this charge to 16 per cent. Against this account all salvage and sales of old apparatus are charged. Gross receipts rather than investments are used as the basis for the depreciation charges in order not to distort improperly the earnings during the various seasons of the year.

An interesting and appropriate talk, not on the afternoon program, was made by Governor Hadley, of Missouri, who visited the convention hall at the instance of Mr. Bertrand, and explained to the public-utility operators his views of the present and proposed Missouri public-service commission laws. Tracing the history of government regulation of natural monopolies, Governor Hadley explained how the present Missouri law provides for each municipality to appoint a local public-service commission which has the power to investigate the workings of companies in its territory, but can only recommend its findings to the local Councils, having no power to enforce its rulings. Thus encumbered the work of the commission is not effective, the enforcement of its findings returns to political circles, and the companies investigated are often subjected to considerable annoyance without result. Governor Hadley favors a "strong" State commission, with powers comparatively similar to those of Wisconsin and New York, its members to be composed of technically qualified experts whose opinions will be weighted with sufficient authority to make them acceptable to both companies and public. The idea of such a State-wide commission seemed to take favorably with the members of the convention, and several requested the Governor to advise them of ways to assist in securing the passage of a bill creating such a commission by the next Legislature. Governor Hadley declared that he would appreciate any individual or co-operative aid in obtaining this commission for Missouri, and left the convention hall amid loud applause. Following the Governor's talk, Secretary C. L. Clary explained how his company had recently undergone an investigation by the local commission, which, probably through its ignorance of the electrical business, had settled upon rates so ruinous that operation would have been impossible.

Following a paper on "'Vertical Gas Retorts," by Mr. S. Watts, Mr. H. W. Clark submitted a description of his electrically driven water-works plant at Mattoon, Ill. The power plant comprises two Chase high-speed tandem-compound engines direct-connected to 550-volt direct-current generators. For adjusting to the growth of load, unequal units, a 90-hp and a 110-hp set have been chosen. Either can be belted to a double-acting triplex pump, delivering 1,000,000 gal. daily to the standpipe and distributing system. This triplex pump takes from a storage reservoir which is supplied from nine 65-ft. wells scattered over a radius of one-half mile, and each pumped by 7-hp electric motors driven from the generators just mentioned. The water is thus pumped twice in accomplishing its total lift, economy being gained, it is thought, in substituting the short-belt drive for the ½-mile electrical transmission of about half the plant output. Each well is covered by a brick and concrete house, the pump mechanism be-

ing connected to a semaphore, which is in motion during the day while the pump runs. For night indication, an electric lamp connected across the motor terminals enables the central-station attendant to know what motors are operating at all times. The efficiency of the electrical plant has been very satisfactory, the operating labor being reduced from 13 to 3 men, while the coal consumption has been cut in half.

Secretary Clary told of his experience with electric pumping in his own town, where the motor-operated plant has been erected next to the central station. The company charges 3⅓ cents per 1000 gal., as indicated by a flow meter, and finds this to be equivalent to the sale of energy at about 5 cents per kw-hour. Professor Shaw described briefly the various modern methods of pumping, and told of the difficulty in finding the static and pumping hydraulic levels, the relation between which is significant of the material through which the supply sifts. Mr. C. S. Lewis believed that the cost of triplex and centrifugal pumps would be found about the same when the higher efficiency of one is compared with the lower upkeep of the other. Mr. C. C. Barnard told of the economy registered by the use of electrically-driven pumps in nearby mines, where electric wires and coal-cutting machines were already installed, reducing the cost of operation much below that of steam-driven pumps. Mr. Lewis testified that the wear of centrifugal pumps is but very slight, even under the most severe conditions of handling entrained gravel and sand.

"Question of Public-Service Plant Operation and Management" was the title of a paper by Mr. George McCullum, an attorney for the central-station interests of Springfield, Mo. The speaker viewed the electricity supply business from the legal standpoint, and advised that the central-station manager should secure and collate in a loose-leaf reference file all ordinances, orders, resolutions, etc., pertaining to his business. He should keep in touch at all times with his city government and endeavor to have a hand in drafting all laws affecting his business, as objectionable features can more readily be eliminated before than after the passage of such bills. The manager should also be familiar with the rates and methods of other companies similarly situated.

Mr. McCullum reviewed the laws of Missouri bearing on fraud or theft of electrical energy, which is punished by a maximum fine of $500 or imprisonment for one year, or both, convictions for stealing energy or tampering with meters to make them register improperly. However, it is often difficult to prosecute successfully under these laws owing to jury prejudice, and in case of failure to convict the company is liable to a damage suit. For this reason such cases are usually best handled through getting the prosecuting attorney to start action on an information, etc. The new Federal income tax law, which becomes effective June 1, levying a 1 per cent tax on all incomes over $5,000, is now before the Washington courts, said Mr. McCullom, the contention being that it is unconstitutional. Mr. McCullom declared for the value of rigorous penal laws for electrical misdemeanors and advocated making severe examples of mischievous or malicious persons caught tampering with or destroying equipment.

The convention banquet was held in the hotel parlors Friday evening.

Saturday morning's session was opened with the reading of Prof. H. B. Shaw's paper, "Data on Electric Plants." In this discussion the writer succeeded well in the effort to consider and combine the available but scattered data on central-station production of electrical energy. Professor Shaw proposed the use of a load factor to be referred to as rated capacity in preference to A. I. E. E. definition, and discussed with the aid of charts the variable and constant charges which make up the central-station expense. Incidentally, he had also analyzed the increase in the number of lamps per capita for Missouri cities during the past five years. All the preceding considerations were combined by Professor Shaw in a study of "over-all efficiency," namely, the efficiency of energy conversion from the coal pile to the generator. Adaptations of Dalby diagrams were used to illustrate the various plant losses of several typical stations, besides one or two of notable efficiency. The manner in which the boilers are fired, said Professor Shaw, presents the greatest opportunity for improvement in the over-all efficiency. Some of the interesting results of Professor Shaw's investigations will be presented here later, together with the discussion which followed his paper.

"The American Diesel Oil Engine in Public Service" was the title of an interesting paper by Mr. Edwin S. Harrison. He described briefly this distinctive type of internal-combustion oil engine. This type of engine possesses marked economy of operation and will operate at from one-half to its full rated load with a fuel consumption of from 6.5 gal. to 8 gal. of oil per hour. This fuel costs from 2 cents to 3 cents per gallon, delivered, producing a kw-hour at the switchboard for from 0.375 cent to 0.3 cent, including all operating costs. The simplicity of fuel supply, which is controlled automatically by the engine governor, and the avoidance of coal and ash handling were pointed out as important advantages of the Diesel engine. This engine has a net efficiency of about 32 per cent—twice that of the producer-gas outfit and almost three times that of the best steam plants. The cost of Diesel equipment, however, is about $70 or $80 per horse-power, including all equipment up to the generator. Mr. P. A. Bertrand brought out the point that owing to inability of internal-combustion engines to carry overloads, the engine capacities of such outfits must be figured large enough to carry the generator overload for emergency service. Mr. C. L. Clary thought that with the low power-factors often encountered engine sizes were usually chosen too high, so that the generators frequently became overloaded with extra-phase current, while their prime movers were yet only partially loaded. Mr. Bertrand showed that the installation of oil engines in place of his present steam plant would have cost five times as much, although Mr. Harrison assured him that the saving in buildings and in other accessories would greatly reduce this ratio; he also called attention to the sustained efficiency and extremely low operating cost of the Diesel engine over a wide range of loads within its rating.

President-Elect R. J. Irvine.

Rain prevented holding the baseball game and outdoor barbeque scheduled for Friday, but the local host, Mr. Bertrand, of the Jefferson City Light, Heat & Power Company, had the roast served in the hotel parlors and the company sat down with several State officials, including Attorney-General E. W. Majors, Auditor John Gordon, Judge J. B. Grant, of the Supreme Court, and Hon. Speed Mosby.

The election of officers and executive committee for 1910 resulted in the following: Mr. R. J. Irvine, Marshall, Mo., president; Mr. F. E. Murray, Louisiana, Mo., Mr. P. A. Bertrand, Jefferson City, Mo., and Mr. J. E. Harsh, Joplin, Mo., vice-presidents; and Mr. N. J. Cunningham, Springfield, Mo.,

secretary and treasurer. The executive committee comprises Mr. P. J. M. Loewe, Moberly, Mo.; Mr. S. E. Bronson, Ozark, Mo.; Mr. Herman Spoehrer, St. Louis, Mo., and Mr. Percy W. Markham, Brookfield, Mo.

Mr. Ralph J. Irvine, the newly elected president of the Missouri association, is general manager of the Marshall Light, Heat & Power Company, of Marshall, Mo., which operates both the electric lighting and gas properties of that town of 6000 population. Mr. Irvine was born in Pettis County, Missouri, in 1876, and has been engaged in mechanical and engineering pursuits since early youth. For five years prior to the formation of the present Marshall company he was associated with the Marshall Electric Light & Power Company. Mr. Irvine is a member of the National Electric Light Association.

The next meeting of the association, on the invitation of Mr. Herman Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, St. Louis, Mo., will be held at St. Louis in April, 1911.

## Electrical Trade Conditions in the Far East—III.

BY FRANCIS B. CROCKER.

To appreciate the difficulty of selling merchandise abroad let us consider the conditions that must be fulfilled in order to make a success of it. These are, first, personal representation on the spot; second, the representative must be thoroughly familiar with and interested in the goods that he is selling; third, he must have had much experience so that he knows how to deal with and humor the Oriental; and, fourth, he must have been sufficiently long and well established in that particular place to have gained local good will and the confidence of his customers, which is a much slower process in the East than with us. In other words, much more missionary work is required. These conditions are peculiarly difficult to fulfill. The distances are great and the expense of sending men out is large. Comparatively few Americans are well acquainted with Oriental methods of transacting business and a still smaller number are in sympathy with such methods. Our natural-born tendencies and our whole business training are in exactly the opposite direction. The European has a very considerable advantage in this respect, his point of view and business methods being semi-Oriental compared with our own. Europe and Asia having been engaged in commerce for a very much longer time than we have, it is questionable whether our ways are really superior to theirs, especially as politeness is practised and required in all of their intercourse, whether commercial or social, to a much more marked degree. Howsoever preference in these matters may differ, the facts must be admitted.

In addition to the four personal qualifications noted above, there are many other conditions that complicate and interfere with the conduct of business in Far Eastern countries. It takes about two months to get an answer to a letter; one month to send out a man or an article under the most favorable circumstances and probably twice as long to ship goods by freight; cablegrams cost $1 or $2 per word; difference of language makes it very difficult to use printed data, instructions, drawings, etc.; merchandise must be packed particularly well to withstand long transportation, loading in and out of vessels, climate, etc.; very often the style of packing, as well as the goods themselves, must suit peculiar Oriental ideas; from three to six natives are required to do one man's work; the time and manner of payments are much more difficult to arrange; standards and specifications are not uniform, in fact, quite different for American, English and German manufacturers. We find, therefore, that there are more than a dozen personal or material conditions in Far Eastern trade differing radically from those at home, with any or all of which it is awkward for the American to deal. It is a common but also a great mistake to assume that a foreign agency is about the same as one in our own country, only further away. All of the 13 differences pointed out stand as difficulties to be overcome, everyone of which is serious and may be fatal. New York seems very, very far away from the traveler in those countries and still further from the resident, who is even more out of touch. One feels almost as if he were on a different planet.

Fortunately, the circumstances are not altogether unfavorable to the electrical trade. The Oriental likes light, partly because of his love for color and show, and also because it is supposed to scare away devils. Of course, this last may not be believed by some of the educated upper classes, but does apply to the bulk of the people who pay electric lighting bills. A large majority of Egyptians, Hindus, Malays and Chinese spend much time and thought in efforts to elude evil spirits and it is universally believed (even in this country) that plenty of light has at least a discouraging influence upon them. This must not be taken as a mere joke, since it is a really important factor that increases the number of customers as well as the average number of lamps used by them, and naturally tends toward all-night illumination. It would be interesting to determine exactly how many foot-candles would be efficacious against demons. Of course, their specific vindictive capacity would have to be known. Whatever the reasons may be, electric lighting of streets, public buildings, hotels, theaters, shops, private houses, etc., is much in evidence in nearly all large Oriental cities and many of the smaller ones. The rate at which this business increases is often as great (expressed as a percentage) as in the United States. The possibilities of the future are almost unlimited, because of the hundreds of millions of population, even after making due allowance for the very large proportion of the hopelessly poor. Where the companies have been established several years, they are usually successful financially and some of them are doing particularly well. Flaming-arc lamps and tungsten incandescent lamps are being introduced nearly everywhere in addition to or as substitutes for the older types of electric lamps. The rates are not low in most cases. For example, the Calcutta Electric Supply Corporation, a successful concern which has been established many years with a monopoly for electric lighting and stationary motor service in that large city, all the electric railways being operated by the Calcutta Tramways Company, Limited, charges 8 annas (16 cents United States) per kw-hour for lighting energy and half as much for motor service, subject to 25 per cent cash discount and further discount for large quantities.

Orientals also have a strong liking for riding on electric railway cars, or, for that matter, traveling by any means of transportation. On the steam railways of India, which gave the first experience of this kind, it was found that the natives used them to a much greater extent than had been expected. This condition has generally been true in the case of other steam or electric railways in the Far East. Tokyo, which had no electric tramways at the time of the writer's first visit 11 years ago, now has 50 miles of double track and this large amount will be doubled in the near future, the franchise having already been granted. It is very noticeable that the number of passengers crowded into a given space is even larger in the Orient than in America, probably because their average size is smaller. The cars being usually divided into second-class and sometimes third-class portions in addition to first class, the crowding is for the most part confined to the lower classes. This arrangement certainly has its advantages not only for the first class, but also to the others who pay a lower fare. The allegation that "all men are created equal" makes trouble when we attempt class distinctions or restriction of immigration, but as this is in the Declaration of Independence and not in the Constitution, it is no part of our laws as often supposed. Moreover, as passengers are not carried free on the cars, they need not be carried "equal." This play upon the words is just as logical as many a legislator's arguments on such questions. At any rate, the Stars and Stripes wave over the Manila electric cars which provide for first and second classes, as well as over the "Jim Crow" cars of the South, and long may they wave!

In general, the equipment and methods employed on Oriental electric railways are similar to those in the United States, being, in fact, often obtained therefrom directly or indirectly. Of course, in the case of cars, motors, etc., the number of manufacturers is somewhat limited, but the boilers, engines, genera-

tors, etc., in the power house can be supplied by many makers, both American and European, the result being that there are many keen competitors whenever such plants are to be installed or extended. For that reason, two or more kinds of engines and generators are often found in the same station, representing not only different builders, but also different countries and hemispheres.

Many of the streets of Oriental cities are narrow, for example, most of those in Canton being from 6 ft. to 10 ft. wide. The side streets especially in nearly all places are of very limited width. But there are usually main streets wide enough to accommodate the single or double tracks of electric railways. The buildings in general are so low and so cheaply built that streets can be widened at much lower cost than would be possible in American or European cities. Nevertheless, narrowness of streets often stands in the way of introducing electric railways in the Far East. Moreover, these streets are usually more crowded than our own. Because of large population, warm climate and exceedingly small houses, the people spend most of their time outdoors. Nearly all buying and selling business is transacted on the sidewalks or in doorways and windows opening directly thereon. Carpenters, metal workers and tailors also pursue their avocations with the same publicity. All of the children play and many of the people sleep in the streets which are literally infested with humanity night as well as day. Of course, this condition constitutes a very serious difficulty in the operation of tramways and naturally results in accidents, but these are not so numerous as would be supposed by anyone passing through these streets swarming with people. The bells of the motormen clang and the natives jump out of the way with an activity that is truly cat-like because exerted only as much as and exactly when the occasion demands. It must be remembered also that life is even cheaper in those countries than it is in our own. The Juggernaut car was doing its work hundreds of years before the advent of the trolley car and automobile, but these modern imitators are speedily making up for lost time. In spite of these unfavorable conditions and the deeply rooted conservatism of the Orient, the electric railway, which has already made remarkable progress there in the last 10 years, will undoubtedly develop still more rapidly and widely during the next decade. All of the natives and most of the foreigners are lazy in hot climates and naturally they would much rather ride than walk. It must also be remembered that from time immemorial only those of the highest rank were able to be carried about, so that the middle and lower classes very gladly avail themselves of the opportunity to enjoy this luxury, being at the same time raised out of their ordinary condition of abject inferiority.

## Wisconsin Rate Commission News.

An optional scale of rates was suggested in a recent decision of the Wisconsin Rate Commission in the matter of the complaint of the citizens of Hudson against the rates and services of the Burkhardt Milling and Electric Power Company. The rates of ten and eight cents per kw-hour for residence and commercial lighting, respectively, together with the discounts allowed, are somewhat discriminatory, but the commission did not see fit to order them changed. The optional rates suggested—11 cents for the first 30 hours' use of the active connected load, 9 cents for the next 60 hours' use, and 6 cents for the excess—follow the cost curve as nearly as possible. The active load is to be 55 per cent. of the connected load. The new scale does not materially affect the revenues.

The hearing was held during the month of February, 1908, at which time the company itself petitioned for an increase in rates. An investigation of the case showed that as the company was now earning about 4.5 per cent. upon a valuation of $86,000, the conditions did not justify any material change in revenues. The company, however, claimed a total valuation of $116,000, which included a sum of $30,000, the value that they placed upon their water rights. While the commission disregarded this question entirely in the valuation, the decision discusses, rather briefly, the general question of the value of water rights for rate-making purposes. Exception is taken to the common method of estimating the value of a water power by the difference in cost of steam and hydraulic generation. For if this difference is capitalized the public is deprived of the benefits which it should receive from a natural resource, which benefits, the commission maintains, should accrue to the public and not to a private party.

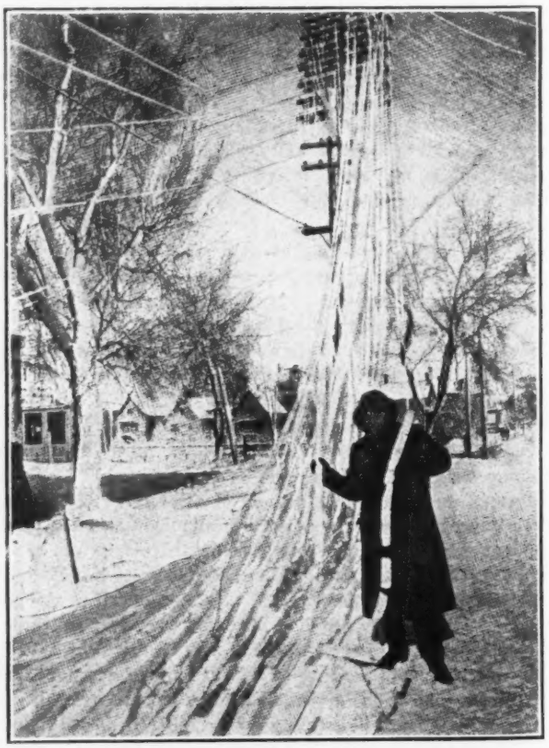
In apportioning the expense account it was found that the general expenses of the Hudson plant constituted over 40 per cent. of the total, whereas the power expenses were less than 30 per cent. of the total. These apportionments are not in accordance with the relations which exist in the average case, as shown by the following table, which represents the average conditions in 38 Wisconsin cities:

Apportionment of Expenses in 38 Wisconsin Cities

| | Hydraulic and Steam, Per Cent. | Hydraulic, Per Cent. |
|---|---|---|
| Power | 51.09 | 56.41 |
| Distribution | 11.49 | 9.22 |
| Consumption | 7.10 | 1.65 |
| Commercial | 4.15 | 2.11 |
| General | 26.33 | 31.80 |

In determining the proper expenses in each class for the plant in question, over $1,000 was deducted from the general expenses. Practically all of this came from the superintendent's salary, which the commission maintained was too high for a plant of this size. The net rate of return, 4.5 per cent., was based upon the revised expense account.

With a view to gathering information whereby an equitable allowance may be made under the provisions of the public utilities law for depreciation and replacement occasioned by sleet, snow and other storms, the engineering staff of the commission is compiling data on the damage caused by storms to the telephone business. From the available data it appears that



Destruction by Storm.

during the period since 1880 there have been at least five or six storms where sleet formed rapidly enough to cause great damage. After a very severe sleet and snow storm which occurred in the State of Wisconsin, Jan. 27-29, 1909, the commission sent out over 500 blank forms to the telephone companies.

These blanks requested information as to the number of interruptions to service caused by the storm and the duration

of such interruptions for both city and rural subscribers. The extent of damage was also requested, covering the number of poles broken, the length of lines down and the cost of repairs, including material and labor. An estimate was also asked concerning the probable revenue losses on toll or long-distance business as well as allowance or refund made to regular subscribers on account of interruptions. Of the 335 reports submitted, over 44 showed damages exceeding $50. The total damage reported by the Independent exchanges was in the neighborhood of $12,000, while the Wisconsin Telephone Company reported $50,000 damages to its local and toll lines. The storm interrupted the service in many cases for more than a week and in some cases the lines were totally wrecked. As the reports were received from the various companies, the amount of damage was plotted upon a map of the State at the location of the exchange reporting. A graphic illustration of the amount of ice which formed on the wires during the storm in question is shown in the accompanying engraving. The wreck demonstrated the error of the use of high pole lines with a large number of cross-arms and open wires. The commission recognizes that storms are one of the hazards of the telephone business involving the question of depreciation and replacements, and seeks to make proper allowances for them.

## Massachusetts Legislative News.

Governor Draper has signed a bill providing that a gas or electric light company may change its location, subject to the approval of the Gas and Electric Light Commission, which may in its discretion authorize such a company, after notice and public hearing, to carry on its business in a city or town other than that named in its agreement of association or charter. The bill authorizing railroad corporations to operate their lines by electricity or other power as may be duly approved by the Railroad Commission has also become a law. The bill providing that no street-railway company shall require passengers whom it permits to ride upon the platform to do so at their own risk has been passed to be engrossed by the House. An attempt has been made in the House to secure a reconsideration of the Henebery bill providing for the awarding of limited franchises to carry freight, to street-railway companies, by municipal authorities. The committee on metropolitan affairs has voted leave to withdraw the bill providing for a better connection between the East Boston and the Washington Street tunnels in Boston. At the hearing on this bill the Boston Elevated Railway Company offered to make arrangements for the more convenient use of one tunnel by passengers in the other. The House has accepted the adverse report of the committee on mercantile affairs upon the Abbott bill for a uniform telephone rate within the city limits of Boston. The committee on public lighting has recommended reference to the next Legislature of the bill prohibiting or regulating charges for the use of electric meters. The committee on street railways has submitted an adverse report upon the bill requiring street-railway companies to equip their cars with lifting jacks. The Senate has concurred in the adverse report of the same committee upon the Mellen bill prohibiting persons from remaining upon the running boards of street cars. Pressure still continues to be brought to bear upon the Legislature to permit the New York, New Haven & Hartford Railroad Company to acquire electric railways in western Massachusetts. A large number of petitions have been received in this connection and referred to the committees on railroads and street railways, sitting together. Public interest in the electrification of steam railroads at Boston continues to increase. On April 14 a vigorous protest against the steam locomotive was lodged by the Boston Landowners' Association with the committee on metropolitan affairs. Counsel Francis Peabody, Jr., emphasized the drawbacks of steam service in injuring property adjacent to the railroads, and contrasted conditions in the electric zone at New York with the smoke nuisance of the Back Bay and the Newtons at Boston. In rebuttal the steam railroad submitted the usual plea for delay in electrifying.

The Massachusetts Gas and Electric Light Commission gave a public hearing on April 12 upon the petition of the Uxbridge & Northbridge Electric Company for approval of an issue of additional stock of a par value of $168,100 for the purpose of paying indebtedness and providing for extensions. The company desires to issue this stock at $100 per share, and was represented by its attorney, Mr. R. B. Clapp. During the hearing it was stated that the company is planning a consolidation of electrical interests in south Worcester County, the organizations effected being the Uxbridge & Northbridge Electric Company, the Grafton Electric Company, the Millbury Electric Company, the Douglas Electric Company and the Upton Electric Company. It is anticipated that many economies in operation and administration will result from the proposed merger, notably in connection with the production and distribution of electricity, the purchase of supplies and materials, and the extension of power and lighting service in the territory between Worcester and the Rhode Island state line. The combined capital stock of the companies is $81,400; the combined structural and quick assets are $297,526, and the debt is $328,724, leaving a deficiency of $112,598. It is planned after the consolidation to make the capital stock $275,000 and to scale the debts so that the deficiency reaches $38,318.

## New York Public Service Commission News.

The Public Service Commission for the First District of New York last week adopted a resolution providing for a public hearing on the draft form of contract for the construction, equipment and operation for the proposed Tri-borough Rapid Transit Company, consisting of the Broadway, Lexington Avenue and Canal Street, the Broadway, Lafayette Avenue and the Fourth Avenue lines and operating rights in other subways. A hearing will be held May 9 devoted to the discussion of the contract for construction, equipment and operation of the entire tri-borough system and the operating rights of the Center Street loop by private capital.

On May 16 the contract for municipal construction, section by section, will be discussed at the public hearing. After the hearings, the commission will consider the various suggestions made and contracts will then be placed for approval by the corporation counsel. After such approval has been obtained advertisements will be begun for letting the contracts. Should no satisfactory bid be received for equipment, construction and operation by private capital, the commission will, with the approval of the Board of Estimate and Apportionment, let contracts for as many sections of the system as can be built with the money available for that purpose. There has already been set aside by the board $13,000,000, which will be available after July 1, and it is hoped that $47,000,000 will be obtained as the result of the passing of the Constitutional Amendment at the last election, authorizing the exemption of revenue-producing bonds from computation in ascertaining the debt limit. Before this latter sum will be available for transit purposes the bill now pending in the Legislature providing for determination by the Appellate Division of the amount of bonds actually self-supporting must be passed.

The Brooklyn Rapid Transit Company has applied to the Public Service Commission for permission to operate the Manhattan end of the Brooklyn Bridge subway loop. This subway is entirely complete, with the exception of the terminal station under the new city building at Chambers Street. The application says that if the company be permitted to operate this subway it would bring traffic across the Williamsburg Bridge to practically the same point in Manhattan that the traffic now reaches over Brooklyn Bridge. It would be the plan of the company to operate many of its lines which now come over the Brooklyn Bridge by way of the Williamsburg Bridge and the subway. This would greatly relieve the Brooklyn Bridge and do much to ameliorate the present serious congestion. The matter was referred to the committee of the whole. The Brooklyn Rapid Transit has also asked for a franchise to operate its surface cars over the Manhattan Bridge and through the Canal Street tunnel. This application was made to the Board of Estimate and has been referred to the

transit committee of that body. The application states that the company will run through cars from various parts of Brooklyn over the bridge for one fare. The local fare of the bridge cars will be 3 cents or two tickets for 5 cents.

At the hearing of the commission of the Manhattan Bridge 3-Cent line, last week, Mr. H. J. Kolb, assistant engineer of the Brooklyn Rapid Transit Company, opposed the granting of the franchise by showing maps to demonstrate that there is already efficient service at the present time, and that if another line were permitted, the intersection of Bridge and Fulton streets, in Brooklyn, would be so badly congested with cars that traffic would be delayed.

The hearings by the commission of the complaints of consumers against the Queens Borough Gas & Electric Company against the present scale of charges have been postponed until April 20. When these hearings were called last week the company showed a disposition to discuss the matter with the consumers themselves and arrive at a new scale of rates. The hearings were postponed in order that some agreement might be reached.

The Pelham Park Railroad Company and the City Line Railroad Company, which are the corporations owning the franchise under which the monorail line is now being constructed in the Bronx from Bartow Station to City Island, have petitioned the Board of Estimate and Apportionment for an extension of three months in which to complete the construction of the road. President Miller, of the Borough of the Bronx, made strenuous objection to granting this petition He contended that no work was being done at all in that territory. The matter was laid over while the construction committee of the board makes an investigation.

The City & Suburban Railway Company has made an application to the Board of Estimate for a franchise to operate a railroad between Brooklyn and Amityville, L. I., over the 72-in. pipe line. The company also wants a franchise to operate a spur from Ridgewood Reservoir to Jamaica Bay.

The Public Service Commission, Second District, has authorized the People's Gas & Electric Company, of Oswego, to acquire all the capital stock, estate, property, rights, privileges and franchises of the Citizens' Lighting Company, of Oswego, and to operate the same. The Citizens' Light Company is authorized to transfer its franchises, etc., to the People's company. The People's Gas & Electric Company is authorized to issue $150,000 additional common capital stock at par, the proceeds to be used for the following purposes and no other: $76,000 par value of common capital stock to acquire the total capital stock of the Citizens' Lighting Company, together with all the franchises, works and system of this company, and $74,000 of stock to be sold at par and the proceeds to be used for paying outstanding obligations which have been incurred in construction, extension and improvement of the property of the company.

The Western New York & Pennsylvania Traction Company has been authorized to increase its capital stock to the sum of $2,600,000, to consist of common capital stock, $1,000,000; first preferred cumulative 6 per cent stock, $600,000; second preferred non-cumulative 5 per cent stock, $1,000,000, and to issue the same for the following purposes: The common stock to the amount of $1,000,000 to be issued in exchange, share for share, for the existing common stock of the company; the second preferred non-cumulative stock to the amount of $1,000,000 to be issued in exchange, share for share, for the existing 5 per cent cumulative stock of the company; the 6 per cent cumulative stock to the amount of not exceeding $500,000 to be issued in exchange for a like principal amount of first and refunding mortgage dated Dec. 1, 1906; the first preferred stock of, but not exceeding, the sum of $100,000 in payment of a like amount of obligations of the company now outstanding, proceeds of the obligations having been used for building the Carrollton-Bradford extension, $16,790; building Salamanca-Little Valley extension, $75,000; construction Little Valley substation building, $2,640; construction portable substation, $1,526; drilling new gas wells, $6,500.

## Self-Contained Electric Street Cars.

For the purpose of obtaining some form of self-contained vehicle to replace the 25 horse cars now used on certain cross-town lines the Third Avenue Railroad Company, New York, placed in experimental service on March 28 a storage-battery car, the performance of which will be closely compared with that of a gasoline-electric car which has been in operation since November, 1909.

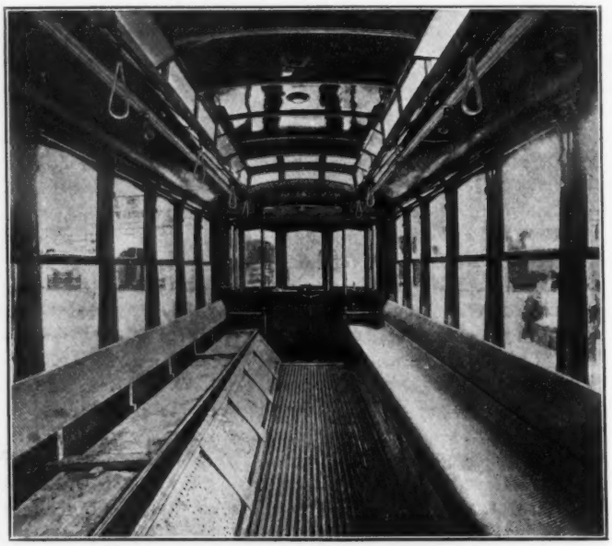


Fig. 1—Arrangement of Batteries Within Car.

The storage-battery car is a reconstructed horse car, and with its truck, weighs 7200 lb. It weighs six tons when carrying its full load of 26 passengers, or only 461 lb. per passenger. Because of the light weight of the car and the use of roller bearings in the journal boxes and ball bearings in the armature journals, only two 5-hp motors are required for operating at the schedule speed of from seven to eight miles per hour, making eight stops per mile. In fact, the car is so light that it can be easily pushed along a level track by one man. Eventually, this car will be operated on streets where the speeds will be only six miles per hour.

The batteries are of the Gould Storage-Battery Company's

Fig. 2—Views of Motor and Ventilating System.

pasted design, composed of 29 plates per cell and 44 cells per set. At 84 volts, the battery has a rating of 420 amp-hours. As shown in the view of the car interior, the batteries are placed under the longitudinal seats on each side. There are four crates of five cells each, and eight crates of three cells each. The battery covers are screwed down tightly. The battery gases are carried off by the natural ventilation which is afforded when the movement of the car sends air through a pipe on each side of the car. As this air passes over the batteries it drives off the odors and exhausts them under the step at the back of the car. There is no odor in the car from the batteries.

Other electrical equipment comprises two 5-hp General Electric motors of the automobile type, operated at 40 amp, 84 volts with 50 per cent overwound field cores. The platform controllers are of the automobile type encased in wood. The car wheels are driven from the motors by two sets of Link Belt geared chains as follows: Two 3-in., 15 teeth steel sprocket flanged wheels, two 22½-in., 113 teeth cast iron, split sprocket flanged wheels, two silent chains, ⅝-in. pitch, 3 in. wide and approximately 10 ft. 8 in. long.

In the accompanying tables are shown the performance data relating to the storage-battery car and also to the gasoline-electric car, a description of which was given in our issue for Nov. 4, 1909. The two cars have been operated over exactly the same route, namely, the 125th Street line. One of the tables covers the experimental and service runs of the storage-battery car on April 5 and the other table is the log of the gasoline-electric car for March. Under service conditions the storage-battery car consumes 0.54 watt-hour per ton-mile and maintains a speed of over six miles per hour with nine stops per mile. This performance is considered very satisfactory as far as speed and energy consumption is concerned. The crux of the problem, however, is the upkeep of the storage battery.

TABLE I.—BATTERY CAR SERVICE RUNS, APRIL 5, 1910.

| | |
|---|---|
| Total time elapsed (hours) | 9.133 |
| Total distance traveled (miles) | 57.78 |
| Speed, m.p.h. (including stop-overs) | 6.33 |
| Actual running time (hours) | 8.04 |
| Speed, m.p.h. (actual running) | 6.68 |
| Kw-hours consumed | 31.24 |
| Kw-hours per car-mile | 0.540 |
| Time lost in stop-overs (hours) | 0.492 |
| Total number of stops | 556 |
| Stops per mile | 9.62 |

TABLE II.—PERFORMANCE OF GASOLINE-ELECTRIC CAR, MARCH, 1910.

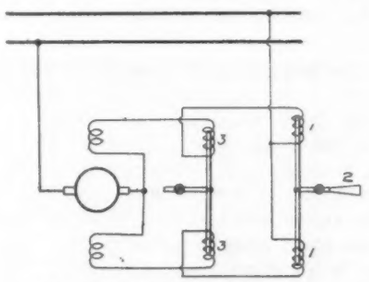
| | |
|---|---|
| Revenue fares | 12,084 |
| Transfers and passes | 3,833 |
| Revenue miles | 2,015 |
| Dark miles | 50 |
| Gasoline, gallons | 1,121 |
| Cylinder oil, gallons | 26.5 |
| Platform expenses | $154.54 |
| Motor grease | $7.32 |
| Other expenses, including two brake shoes | $30.25 |
| Gasoline per revenue mile, .5563 gal. at 11.35 cents | 6.314 cents |
| Cylinder oil per revenue mile, .01315 gal. at 38.50 cents | .506 cent |
| Platform expenses per revenue mile | 7.670 cents |
| Motor grease per revenue mile | .363 cent |
| Other expenses per revenue mile | 1.501 cents |
| Total expenses per revenue mile | 16.354 cents |
| Gasoline per mile of gross miles, .5413 gal. at 11.35 cents | 6.144 cents |
| Cylinder oil per mile of gross miles, .0128 gal. at 38.50 cents. | .493 cent |
| Platform expenses per mile of gross miles | 7.462 cents |
| Motor grease per mile of gross miles | .353 cent |
| Other expenses per mile of gross miles | 1.460 cents |
| Total expenses per mile of gross miles | 15.912 cents |
| Total revenue per revenue mile | 29.985 cents |
| Total revenue per mile of gross miles | 29.174 cents |
| Total revenue for month of March | $604.20 |
| Total cost of operation, March | $329.55 |

The table covering the operations of the gasoline-electric car shows that in 27 days the cash revenue amounted to $604.20, and the cost of operation to $329.55. A total of 15,917 passengers was carried. Compared with the figures for the first week in December, 1909, the total operating expenses per revenue-mile increased from 13.717 cents to 16.354 cents, while the earnings decreased from 30.97 cents to 29.985 cents. Part of the higher operating cost was due to an increase in the consumption of gasoline, which raised this item from 4.83 cents to 6.314 cents per revenue mile.

## Motor Starting Device.

A novel method of starting, stopping and reversing a motor with a pilot motor, the action of the pilot motor being automatically controlled, is covered in a patent issued to Mr. August Sundh. The method of controlling the pilot motor, which operates the reversing switch and cuts in and out the taps from the secondary of the transformer, forms the most interesting part of the device. The pilot motor is of the bipolar single-phase commutator type with field windings opposed.

The field windings are joined to one brush of the machine, thus leaving three terminals of a star connection, two legs of which are the field windings and the third the armature winding. The armature leg is connected to the line directly, while the other legs have each two impedance coils with movable cores, connected in series between the motor and the line. As long as the impedance is the same in both legs there will be no resultant motor torque, but as soon as the impedance in one leg differs from that in the other the field winding in the lower impedance leg will produce more flux than its opponent and rotation will take place. Referring to the illustration, the cores 1 1 are connected mechanically to the master-control handle 2 and the cores 3 3 are connected to a mechanism operated by the pilot motor. When lever 2 is thrown one way the balance of impedance in the two legs is upset and the motor rotates in the direction controlled by the field in the low leg; by its rotation the motor operates the starter of the large motor and at the same time reaches a balance of the impedance in its field circuits by operating the cores 3 3, so as to counterbalance the displacement of those operated by the controller handle.



Sundh Motor-Starting Device.

## AMERICAN ELECTRICAL ENGINEERS—X.

### F. G. Baum.

Mr. Frank George Baum was born at Sainte Genevieve, Mo., July 18, 1870. After receiving a common-school education he entered Stanford University in 1894, from which he received the degree of A. B. in electrical engineering in 1898 and that of E. E. in 1899. In 1899 he entered the employ of the Standard Electric Company of California, where he took up high-tension transmission work, and shortly afterward entered the works of the Stanley Electric Company, of Pittsfield, Mass., where he remained for about one year. From 1900 to 1902 he was instructor in electrical engineering at Stanford University, during which period he also did special work in electric energy transmission for the Bay Counties Power Company and other companies. In March, 1902, he became electrical engineer of the California Gas & Electric Corporation, and shortly after transmission engineer and superintendent of the same corporation, with charge of hydraulic and electrical construction and of operation. During this period he had direct charge of the design and installation of 47,000 kw of electrical generating machinery, of which 35,000 kw is operated by water-power, and also designed and installed numerous substations. From 1907

to date Mr. Baum has practiced as a consulting engineer, with special reference to hydroelectric power developments, and in this capacity has done work for practically every large energy transmission company on the Pacific Coast.

Mr. Baum put into practical form the type of high-tension oil switch now used throughout the system of the Pacific Gas & Electric Company and since adopted by many other companies. He also invented the outdoor high-tension switch used throughout the Pacific Gas & Electric Company's system, and which is being introduced quite generally in the Western transmission systems.

Mr. Baum has contributed a large number of articles to the technical press dealing with electric energy transmission, transformers, alternators, synchronous motors and converters. Some of the subjects thus treated are the regulation of transmission systems; effect of wave-form on capacity of transmission lines; surges in transmission systems; conditions of maximum transformer efficiency; effect of magnetic leakage on transformer regulation; effect of leading and lagging currents on transmission regulation; effect of armature current on the wave-form of alternators; synchronous reactance; synchronous motor stability and overload capacity curves, etc.

F. G. Baum

In 1900, in conjunction with the late Dr. F. A. C. Perrine, Mr. Baum presented the first paper published on the calculation of the charging current in three-phase transmission lines, and developed his method of calculating the regulation of transmission systems, which forms the basis for his "Alternating-Current Calculating Device," published in 1902. His paper on "Surges in Transmission Systems," presented in 1902 before the Pacific Coast Transmission Association, first pointed out in a practical way a simple method of calculating the rise in pressure due to surges in transmission systems. In 1904 he presented a notable paper before the International Electrical Congress, St. Louis, on high-tension, long-distance transmission and control. He is the author of a book entitled "The Alternating-Current Transformer," and of a device whereby the regulation of an alternating-current line may be simply calculated.

Mr. Baum is a member of the American Institute of Electrical Engineers, of which he has been a vice-president, and a member of its high-tension transmission committee; of the American Society of Civil Engineers, and American Society of Mechanical Engineers.

# CURRENT NEWS AND NOTES.

**Convention of the A. I. E. E.**—The annual convention of the American Institute of Electrical Engineers will be held at Jefferson, N. H., in the White Mountain district, on June 27, 28, 29 and 30. The headquarters will be at the Waumbeck.

**New York City Change in National Electrical Code.**—Commissioner Thompson of the Department of Water Supply, Gas and Electricity of New York City has ordered that the use of set-screw connectors for outlet boxes and other conduit and armored cable fittings will be prohibited in that city after June 1, 1910, this prohibition not to exclude, however, the set screw which is employed for securing the fittings to the gas outlet.

**N. E. L. A. Convention.**—Arrangements for transportation to St. Louis for the convention of the National Electric Light Association have been completed for the New England, New York and New Jersey delegations. Special cars carrying the New England delegation will leave the South Terminal, Boston, on Sunday, May 22, attached to the 11:30 a. m. train for St. Louis, due at Albany at 5:25 p. m.. Special cars carrying the New York and New Jersey delegations will leave the Grand Central Station, New York City, May 22, attached to the Southwestern Limited, leaving there at 2:45 p. m. and due at Albany at 5:25 p. m. From Albany the New England, New York and New Jersey delegations will all go through to St. Louis on the Southwestern Limited, due at St. Louis Monday, May 23, at 1:45 p. m.

**Preparations for Southwestern Convention.**—Rather elaborate preparations are under way for the forthcoming annual convention of the Southwestern Electrical & Gas Association to be held in Beaumont, Tex., on May 12, 13 and 14. There will be several instructive papers, and an exhibit of electrical appliances will form a feature of the convention. The local Chamber of Commerce has appointed committees on general entertainment, hotel accommodations, finance, exhibits, entertainment for the ladies (a committee made up of ladies) and Sons of Jove. The exhibit hall will be a room in the Kyle Theater Building, and the lobby of the theater will also be available for the overflow exhibits. Business meetings will be held during the forenoons of the three days of the convention. Mr. E. T. Moore, of 300 Commerce Street, Dallas, Tex., is secretary of the Southwestern association, and Mr. Joe E. Carroll is president of the Beaumont Chamber of Commerce, which is active in making the local arrangements.

**Electric Railway Farming Special in Massachusetts.**—A novel application of transportation educational methods was made last week by the New England Investment & Security Company in co-operation with the Massachusetts Agricultural College and the State Department of Forestry. Four special electric cars fitted with agricultural exhibits were operated for three days in the territory between Springfield and Worcester, a total trackage of about 300 miles being traversed. About 20 lecturers, comprising members of the faculty of the Agricultural College and prominent State officials, accompanied the special cars, and stops were made in South Hadley, Russell, Huntington, Springfield, North Wilbraham, Brimfield, Sturbridge, Charlton, Oxford, Worcester, Holden and Sterling. Short talks on agricultural topics were given at each stop. The company stated that this is the first instance where better farming has been stimulated by an electric railway exhibit train, and it was pointed out that the closer relations between the public and trolley systems compared with steam railroads and the territory which they serve afford better opportunities for industrial improvement under the initiative of electric railway companies. President L. S. Storrs, of the railway company, was the originator of the trolley farming special, which attracted wide interest on its trip.

**Grounded Secondaries.**—Estes Park, Colorado, has just completed the grounding of all secondaries, as the result of trouble from primary voltage entering buildings where ungrounded secondaries were used. The transmission is at 6600 volts, with direct step-down to 110-220-volt secondary.

**Smoking on Street Cars.**—The Chicago & Oak Park Elevated Railroad Company, having abolished smoking on all its elevated railway cars in Chicago, the other surface and elevated railway companies are talking of following suit. The health commissioner is reported to favor the change, and unity of action on the part of all the companies is suggested. At present all elevated lines except the Oak Park have one smoking car in each train, and on the surface cars smoking is allowed on the front platform.

**Chicago Section of A. I. E. E.**—A joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former society in the Monadnock Building, Chicago, on the evening of April 27. At that time Mr. William B. Jackson will present a paper on "De preciation and Reserve Funds of Electrical Properties." A large attendance is expected, as the subject is one of well-recognized importance.

**Convention of the Nebraska Electrical Association.**—The annual convention of the Nebraska Electrical Association will be held at Lincoln, May 3, 4 and 5, 1910, at the New Lindell Hotel. A tentative program has been prepared, which is subject to change, but which contains papers on concrete-pole construction, use of tungsten lamps, power plant reports, power plant operation, increasing motor load, new business, electric distribution, electric meters, and rates in cities of 1000 to 2000 inhabitants. The papers and discussions will take the entire three days. The president of the association is Mr. B. C. Adams, of Lincoln. Mr. Frank McMaster, Beatrice, Neb., is secretary.

**Tungsten Mining and Milling in Colorado.**—The tungsten mining and milling industry has received a great impetus in Boulder County, Colorado, as a result of improved methods and better prices. The Eureka Tungsten Mill has just begun operations, using a belt table arrangement of new design, and recovering an unprecedented proportion of the tungsten. The mill is a brick structure and entirely electrically operated. The Primos Mill will also handle tungsten ores, and an additional income will be derived from the sale of about 2000 hp from its own water-power development at Lakewood, Col. At present its power will be derived from the Central Colorado Power Company's 100,000-volt transmission system.

**Canal Employees May Use Electricity for Lamps Only.**—By a general order, Colonel Goethals, chairman and chief engineer of the Isthmian Canal Commission, gives notice that electricity is furnished employees' quarters for lighting only, and that the use of electrical energy for heating, cooking or motors in connection with devices purchased and connected up by the occupants of commission quarters is not approved. Employees who have already acquired such devices may continue to use them, with the understanding that they will be required to pay for all electricity used at the rates which will be established. They will not be permitted to use any other apparatus of this character which they may subsequently purchase.

**Large Cars for Electric Railway.**—The Southern Pacific Company has placed an order with the American Car & Foundry Company for 125 all-steel passenger cars to be used on its newly electrified 1200-volt lines at Oakland, Cal. The order includes 40 motor cars, 25 combination coach and baggage motor cars and 60 trailers. The cars are 72 ft. 4½ in. in length over all, 10 ft. 4 in. wide and 13 ft. high. The motor car complete weighs 104,000 lb. and has seating capacity for 116 passengers, or 896.6 lb. per seated passenger, which is a low weight. The cars are noteworthy in that the aisle is placed off center, the seats on one side having room for three passengers and on the other for two passengers each. The unusual width makes this possible. Turtle-back roofs are used.

**Colorado Electric Club.**—At the meeting of the Colorado Electric Club, in Denver, on April 7, Dr. George L. Knapp, one of the editors of the *Rocky Mountain News*, addressed the club on "The Value of Getting Together." His remarks were greatly appreciated. On the following morning an editorial appeared in the paper with which Dr. Knapp is connected headed "The Electric Club." In this the writer, commenting on the appearance of the men of the club, remarked that "the mark of the trade," such as might be noted in a group of doctors, lawyers, clergymen, soldiers or sailors, was absent. "The industry is too new to have sorted out and fixed a type. . . . The flexible thumb of the shop-trained mechanic lay next to the inturned, suppressed thumb of the office man."

**Voluntary Insurance for Employees.**—The United States Steel Corporation has adopted and will put into operation at once the most comprehensive plan yet adopted in this country for providing for injured men and their families. Under the plan relief will be paid for temporary disablement and for permanent injuries and for death. The relief is greater for married men than for single men and increases according to the number of children and length of service. During temporary disablement single men receive 35 per cent of their wages and married men 50 per cent, with an additional 5 per cent for each child under 16 and 2 per cent for each year of service above 5 years. In case men are killed in work accidents, their widows and children will receive 1½ years' wages, with an additional 10 per cent for each child under 16 and 3 per cent for each year of service of the deceased above 5 years.

**New York City Changes in Electrical Code.**—Commissioner Thompson, of the Department of Water Supply, Gas and Electricity, announces an amendment to Rule 21-d of the National Electrical Code relating to fixture wiring. The portion of the second paragraph reading as follows is to be replaced by new matter: "Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in the case of large chandeliers. (For exceptions, see rule on theater wiring and list of fittings for rules for electric signs.)" The new matter is as follows: "In cases where wiring equal in size and insulation to No. 14 gage approved rubber-covered wire is carried direct into keyless sockets or receptacles, the circuits may be so arranged that not more than 1320 watts will be dependent on the final cut-out; provided, however, that the location of sockets and receptacles is such as to render unlikely the attachment of flexible cords thereto."

**Automatic Telephone Rehabilitation in Chicago.**—The Subway Telephone Construction Company, of which Mr. Joseph Harris is president, is publishing page advertisements in the Chicago daily papers to acquaint the public with the details of the plan for rehabilitating the automatic telephone service of the Illinois Tunnel Company, now in the hands of receivers. In addition to information previously given in these columns, the exact boundaries of the district to be covered by the initial installation are given as follows: On the north by North Avenue, on the east by Lake Michigan, on the south by Twenty-second Street and on the west by Ashland Boulevard, with an extension covering the Stockyards district. At first only business telephones will be installed. The rates will be: When there is in service an installation of 10,000 to 15,000 telephones, $1.75 a month; 15,000 to 17,500, $3.50 a month; 17,500 to 20,000, $5.25 a month; 20,000 and over, $7 a month. Rates are never to exceed $84 a year for business telephones and $50 a year for residence telephones.

**Canadian Electrical Association.**—The next meeting of the Canadian Electrical Association will be held at the Royal Muskoka, Lake Rosseau, July 6, 7 and 8. Mr. T. S. Young, Confederation Life Building, Toronto, Ont., is secretary of the association.

**Michigan and Indiana Telephone Association.**—The Michigan and Indiana Independent Telephone Companies will hold joint annual meetings at South Bend, Ind., on May 11 and 12. Papers dealing with telephone business methods and policies will be presented by Messrs. John W. Coffey, W. S. Vivian, H. F. Farwell, N. G. Hunter, R. C. Stephenson, William Fortune, W. A. Jackson and J. B. Stoll.

**Canadian Telegraph Night Letter Service.**—The Great Northwestern and Canadian Pacific Railway Telegraph companies put into effect on April 13 a night letter service between all points in Canada and the United States. Letters containing 50 words or less are transmitted for the same amount of tolls as is charged for a 10-word message day rate, and one-fifth of this rate will be charged for each additional 10 words or less. Code or cipher words are not permitted.

**"More Daylight" Plan Unsatisfactory in Cincinnati.**—The City Council of Cincinnati on April 11 repealed the ordinance whereby "more daylight" was to be secured by setting local clocks two hours fast from May to October. If carried out this plan would have rendered unnecessary a large proportion of the artificial illumination now demanded during the summer months, and, therefore, it is of interest to observe that the proposed "reform" has been abandoned.

**Chicago's Partnership with Street Railway Companies.**—Payments amounting to $1,286,599 made on April 10 to the city of Chicago by the Chicago City Railway Company and Chicago Railways Company brings the "traction fund" in the city treasury up to about $4,300,000. Under the "settlement ordinances" the companies pay 55 per cent of their "net" receipts to the city, and in three years these payments have amounted to the sum mentioned. The money will probably be used to help build the passenger-traffic subway.

**Transatlantic Wireless Service.**—It has been announced that the wireless transatlantic service from Glacé Bay, N. S., will be re-established during the present week. Under the personal direction of Mr. Marconi new machinery and improved apparatus have been installed at Glacé Bay. The new arrangements provide for communication, not only between America and the United Kingdom, but also between this country and Europe. Tests will soon be made for communication between England and places in the interior of Canada.

**Lighting in Siam.**—Consular reports state that outside of Bangkok, where electricity is used for lighting, kerosene and other oil-burning lamps and candles supply the means for lighting and illuminating purposes in Siam. During the fiscal year 1908-9 the imports of lamps into Siam amounted to $114,000, of which about $12,000 worth were from the United States. The imports of candles during the same year amounted to $109,000, nearly all from Singapore, Hong Kong and Burma, only $2,791 worth being from the United States. The importation of candles is gradually increasing.

**St. Louis League of Electrical Interests.**—At a dinner to be given by the League of Electrical Interests of St. Louis at the Mercantile Club, in that city, on April 21, there will be speeches by Mr. Henry L. Doherty, of New York, former president of the National Electric Light Association and president of the Doherty Operating Companies, and Mr. F. W. Lehmann, of St. Louis, former president of the American Bar Association and chairman of the Board of Freeholders of St. Louis. Both gentlemen will address themselves to the subject, "The Treatment of Quasi-Public Corporations by the Public."

**Meetings of I. E. S.**—At the May meeting of the New England Section of the Illuminating Engineering Society a paper on street fixtures will be presented by Mr. Charles O. Baker, and one on fixtures for interior lighting will be read by Mr. Le Fevre. Mr. M. C. Whitaker will read a paper on the relation of the chemical composition of the gas-lamp mantle upon the color of the light emitted at the May meeting of the Philadelphia Section. At the May meeting of the New York Section Dr. C. H. Sharp and Mr. P. S. Millar will present a paper on illumination tests, and Mr. C. O. Bond will lecture on standards of light.

**Is Chicago the "Smoky City"?**—An American correspondent of an English electrical journal refers to Chicago as the "Smoky City." This is a title that is sometimes applied to Pittsburgh, and probably Chicago is not especially desirous of sharing the honor, even though the smoke indicates industrial activity. There is, however, too much smoke in Chicago, and the city smoke department, backed by public sentiment and the newspapers, is endeavoring to mitigate the nuisance by bringing about the electrification of steam-railroad terminal and smokeless combustion of fuel in stationary power plants. The local electric service company also stands ready to supply electrical energy to supplant private plants to an unlimited extent.

**Government Suit Against Economy Light & Power Company.**—Issue has been joined in the United States Circuit Court at Chicago in the case of the United States against the Economy Light & Power Company, of Joliet. The defendant has built a dam as a part of its hydroelectric plant at Dresden Heights on the Desplaines River, near the point where that river joins with the Kankakee River to form the Illinois River. The State of Illinois brought suit to stop work on this water-power development, alleging that the company was obstructing a navigable stream, but was defeated in the State Supreme Court. Holding that the river was not navigable, the company did not obtain a permit from the War Department of the United States Government before beginning work on its hydroelectric development. The Department of Justice of the national Government, despite the decision of the court of last resort in the State, takes the position, apparently, that the river is navigable, and hence the present suit has been brought. The taking of testimony will soon be begun, but it will no doubt be several months before a decision is reached, and after that there may be an appeal.

**Extravagant Claims for Wireless Telephoning.**—That the wireless telephone in its present stage of development is impractical, expensive and unsuited to commercial work was the statement made by Prof. Frederick A. Rogers, assistant professor of electrical engineering and physics at Lewis Institute, Chicago, during an address before the student body in the Institute auditorium, April 11. Professor Rogers had been aroused to action by the claims of a wireless-telephone company, which, in display advertising, recently referred to the Lewis Institute, Armour Institute and the University of Chicago, as indorsing its system, quoting the professor himself as expressing opinions relative to the operation of its apparatus which he feels sure he never voiced. Professor Rogers' repudiation of the extensive claims of the promoters and warning of the lay public then followed. A somewhat similar example of widely heralded exploitation of wireless telephone operation, which was published in the Chicago papers several weeks before, and which could not be confirmed when the persons most concerned were approached for details, was to the effect that the Southwest Lake Tunnel intermediate crib, where a number of men lost their lives by being cut off from shore when the superstructure burned 15 months ago, was to be connected with the shore by wireless telephone to avoid possibility of repetition of the accident. This report in the papers turned out to be as much news to the officials of the construction company which is carrying on the crib work as to any other reader.

## RESERVE POWER STATION.

### The Power Plant and System of the Syracuse Lighting Company.

By M. G. Kennedy.

THE Syracuse Lighting Company serves a territory comprising the city of Syracuse and the villages of East Syracuse, Fayetteville, Liverpool, Camillus, Eastwood, Minoa and Solvay, which embraces a total population of approximately 150,000. The central station of the company stands upon the site of the city's first electric lighting station, quite naturally selected adjacent to the Oswego canal, from which water is now drawn for condensing purposes. With the growth of business the plant has expanded, so that now, after having passed through the rapids of electrical development, it has emerged a combination steam generating station and substation supplying a connected load of 20,000 kw through 10,040 meters.

The service supplied generally is 60-cycle, single-phase for lamps and three-phase for motors, supplemented with a 500-volt, direct-current service conserved for the business section of the city and territory close to the station. The exception to this is the service furnished to the village of Camillus, wherein a frequency of 25 cycles is used for both lamps and motors.

The central and business section of Syracuse is covered with a subway system, which is owned by the company. Into this there are carried 10 single-phase, 2300-volt circuits for lighting and four 500-volt, direct-current circuits for motor service. The overhead distribution system is made up of six 2300-volt, single-phase feeders for lighting, five 2300-volt, three-phase and four 500-volt, direct-current feeders for general industrial purposes and two 6600-volt, three-phase feeders for large outlying motor users.

Street lighting in Syracuse is accomplished with 4-amp magnetite arc lamps, and that of the outlying districts with 6.6-amp, alternating-current enclosed arcs and series tungsten incandescent lamps. The entire service is made up of 1626 magnetite lamps, 24 enclosed alternating-current lamps and 75 tungsten incandescent lamps, all controlled by 34 overhead and four underground circuits.

Of the outlying villages, East Syracuse, Fayetteville, Liverpool and Solvay are supplied with energy over three three-phase, 2300-volt feeders, each feeder terminating in a transformer station containing an automatic voltage regulator and a constant-current transformer for the street lamps. From these stations the local distribution is controlled. Energy for the village of Camillus is fed over a three-phase, 11,000-volt, 25-cycle transmission line ending in a substation containing step-down transformers, voltage regulator and street-lighting apparatus. The local distribution consists of 440-volt, three-phase circuits for motors and 220-volt, three-wire mains for commercial lighting. Street lighting is done with 32-cp series tungsten lamps.

All of the above-described system, with the exception of that at Camillus, receives energy from the central station in Syracuse, having a rated steam-generating equipment of 5700 kw, and substation apparatus rated at 3600 kw. The company, in addition to generating energy by steam, purchases 25-cycle energy from the Niagara, Lockport & Ontario Power Company, transmitted from Niagara Falls over two 150-mile, three-phase transmission lines at 60,000 volts. The energy is received and paid for at the substation of the Syracuse Lighting Company, located in the village of Solvay, about 4.5 miles from the steam station.

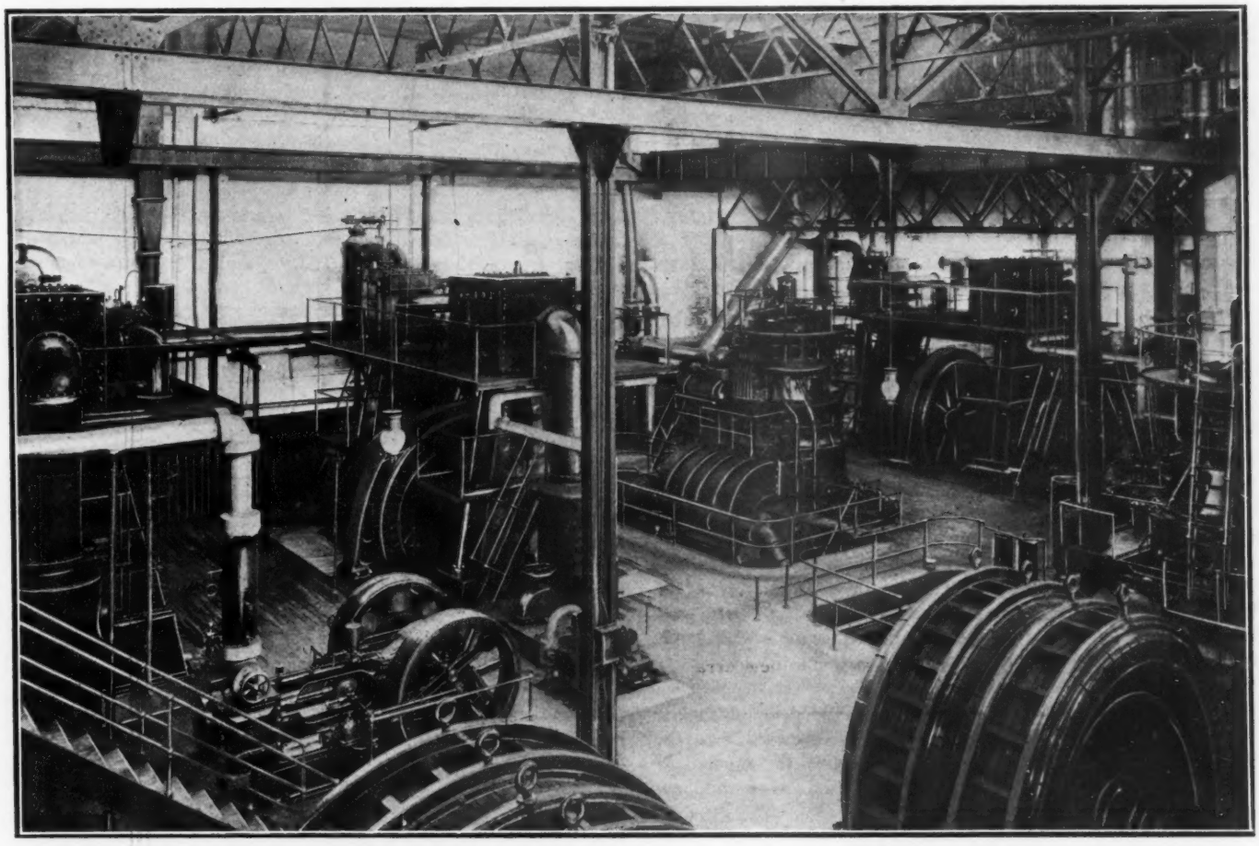


Fig. 1—Steam-Driven Apparatus in Station of Syracuse Lighting Company.

The e.m.f. at the substation is decreased to 11,000 volts and energy is transmitted over two three-phase lines to the steam station in Syracuse and over one three-phase line to Camillus. The three lines are of aluminum cable.

At the steam station the energy is delivered as 60-cycle, 2300-volt, three-phase current, and 550-volt, direct current, through

frequency changers and motor-generator sets, and without conversion, it is fed directly at 11,000 volts into the street-lighting apparatus for the Syracuse district.

The central-station building is of brick and steel construction, rectangular in shape and divided about equally as to width by a longitudinal partition wall into boiler-room and engine-room sections. Of the boiler-room, the side near the engine-room is taken up with nine boilers, the stack, the pumproom, and the

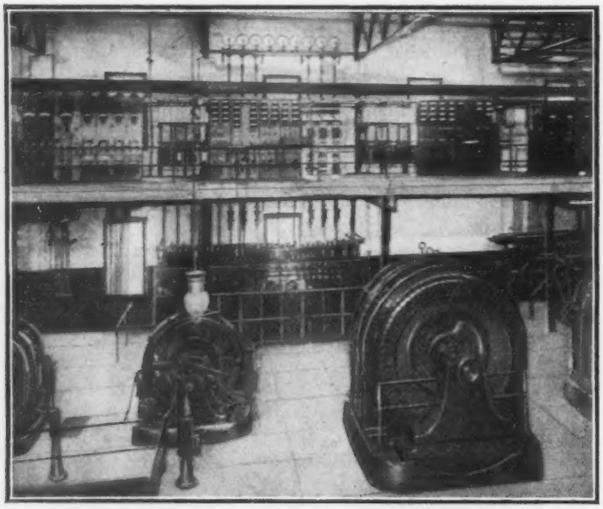


Fig. 2—Substation Section of Engine Room.

water purifying plant. Immediately in front, an aisle, or working space, 23 ft. wide, extends the full length of the building. Over this aisle the coal bunkers are erected. On the opposite side and filling the room for its entire length 13 boilers are set up, each equipped with a Murphy smokeless furnace.

The complete boiler equipment consists of 22 330-hp Heine water-tube boilers, 14 of which are coal fired, and 8 arranged for burning oil, being equipped with Calorex burners. Both fuels, coal and oil, are received by rail. The former is unloaded by a belt conveyor and carried either to the boiler-room or coal pile, depending upon conditions; from the pile it is picked up by a traveling crane, placed upon a conveyor and carried to the overhead pocket in the boiler-room, from which it is let down upon the floor. The oil falls by gravity from the tank cars into iron storage tanks buried in the ground near the railroad siding; from there it is pumped to overhead tanks erected outside the boiler-room, and from them fed by gravity to the burners.

The engine-room may be considered as divided longitudinally into halves. In the section adjacent to and parallel with the boiler-room the steam units are set up, while the other half contains the substation equipment and is known as the substation section.

The steam-driven installation consists of two 1500-kw, 2300-volt, three-phase Curtis turbines, equipped with Wheeler surface condensers and Edwards air pumps; three 600-kw, 2300-volt, three-phase generators, each directly connected to a McIntosh & Seymour vertical cross-compound engine; one 850-kw, 550-volt, direct-current generator, directly connected to a McIntosh & Seymour horizontal twin-tandem compound engine. Blake jet condensers are used with the reciprocating engines.

The substation section of the steam station contains apparatus for the utilization of purchased energy comprising two 1000-kw, three-phase, 25-cycle to 60-cycle, 11,000-volt to 2300-volt frequency changers; two 500-kw, 550-volt direct-current generators, each driven by a three-phase, 11,000-volt, 25-cycle synchronous motor, and 32 50-lamp, constant-current transformers, 11,000-volt, 25-cycle primary, 4500-volt, 4-amp secondary with oil-immersed mercury-arc rectifiers.

Eighteen feet above the floor a switchboard gallery, 16 ft. wide, extends the entire length of the building on the substation side, and is continued on around one end-wall for the full width of the engine-room. Upon the end gallery the switchboard panels for the steam-driven apparatus are set up, and beneath it the remotely controlled generator switches and feeder regulators are installed. The panels are of blue Vermont marble.

The side gallery may be really considered as divided into two sections, each containing a switchboard with space reserved for future panels similar to those now erected upon them. The section near the end gallery contains the switchboard controlling the 11,000-volt incoming lines, the electrically driven apparatus, the exciters and the outgoing feeders. Above it and at the middle of the section the incoming lines enter the building, pass down the wall to the under side of the main floor, and enter a bank of cell-mounted switches erected on the main floor directly under the entrance. The bank is a self-contained arrangement of 11,000-volt switches and busbars, and forms an isolated high-tension equipment from which insulated cables are carried to the under side of the main floor and led to the electrically driven apparatus.

The switchboard is erected 10 ft. from the wall. It is built of slate panels having a dull black finish, and with the exception of those used for direct-current control are operating panels for remotely controlled electrically operated switches. Five feet behind the panels the 2300-volt oil switches are set up on racks, as shown in Fig. 3, and over them extend the 2300-volt busbars and disconnecting switches, the whole arrangement utilizing the space to its best advantage and providing ample room for operating and repairs. All of the equipment was furnished by the General Electric Company.

The remaining section of the side gallery is occupied by the switchboard for the street-lighting apparatus, which is shown in Fig. 4, and controls an installation embracing an equipment

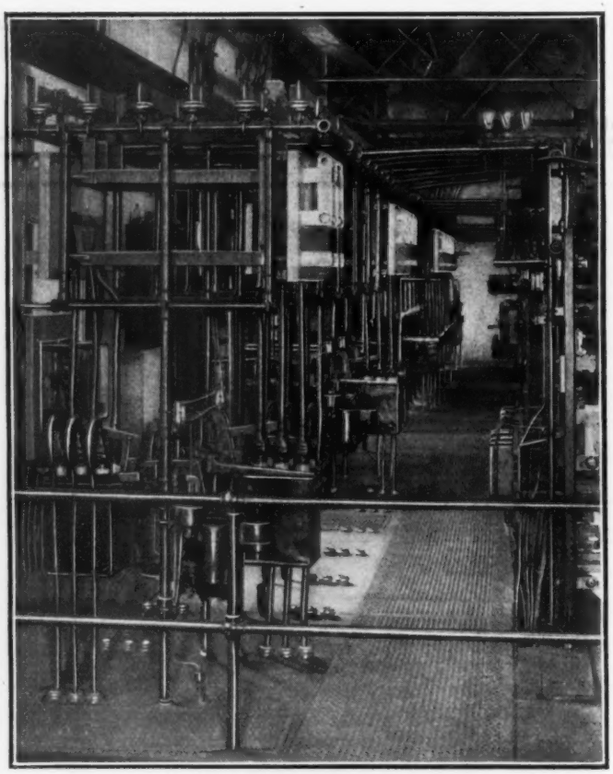


Fig. 3—Rear of Main Switchboard.

of 32 50-lamp, 11,000-volt, 25-cycle, constant-current transformers, and 32 oil-immersed mercury-arc rectifiers that supply energy to 4-amp magnetite arc lamps. Sixteen marble panels having a dull black finish are set up in four sections, 10 ft. from the wall. Each panel controls two transformers through one oil switch, two rectifiers and two 50-lamp circuits, and has

mounted upon it in addition to the secondary switches, two Bristol recording ammeters, one indicating ammeter and a plug receptacle. This latter provides a ready connection for the insertion in either circuit of a portable standard ammeter.

Directly behind their respective panels stand the tanks for the oil-immersed rectifiers, and 7 ft. beyond them, mounted against the building wall, are the transformer primary switches. This arrangement, as shown in Fig. 5, provides a passageway 4 ft. wide between the tanks and switches.

The constant-current transformers are installed upon the

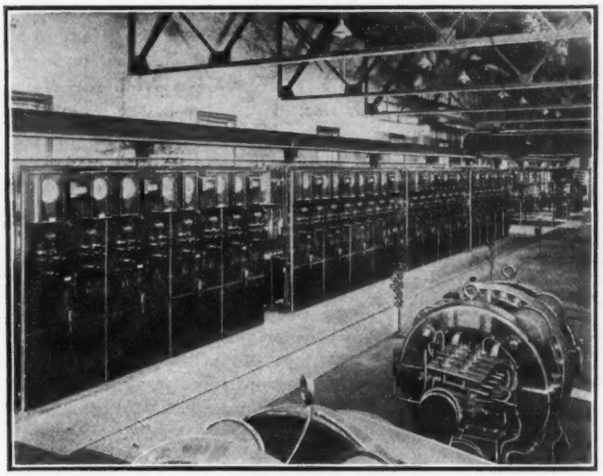


Fig. 4—Arc Lamp Switchboard.

main floor of the station, directly below the arc switchboard gallery. They are laid out in two rows, as shown in Fig. 6, with a 6-ft. aisle between, that runs parallel with the switchboard above; so arranged and taken with the apparatus located above on the gallery floor, the layout makes a simple, compact and accessible installation.

The substation at Solvay previously referred to is the receiving station for energy purchased from the Niagara, Lock-

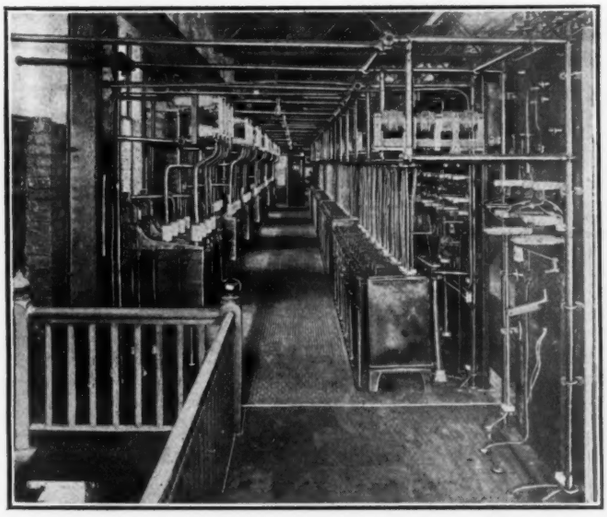


Fig. 5—Rear of Arc Lamp Switchboard.

port & Ontario Power Company, and has the sole function of stepping down the voltage from 60,000 volts to 11,000 volts to make transmission practicable through the city of Syracuse.

It is a rectangular building of brick and concrete and is shown in Fig. 7. It contains an equipment of four 1000-kw, 60,000-volt to 11,000-volt, single-phase, oil-cooled and water-cooled transformers, and a simple installation of busbars, cables and switches. Fig. 8 is the wiring diagram of this station. One of the transformers is held as a spare, but a simple and permanent switching arrangement is provided to allow quick paralleling with any of the three working transformers.

The building, a plan and elevation of which is shown in Fig. 9, is divided longitudinally by a partition wall into two compartments, one containing the 60,000-volt apparatus and the other the 11,000-volt equipment. The high-tension compartment is

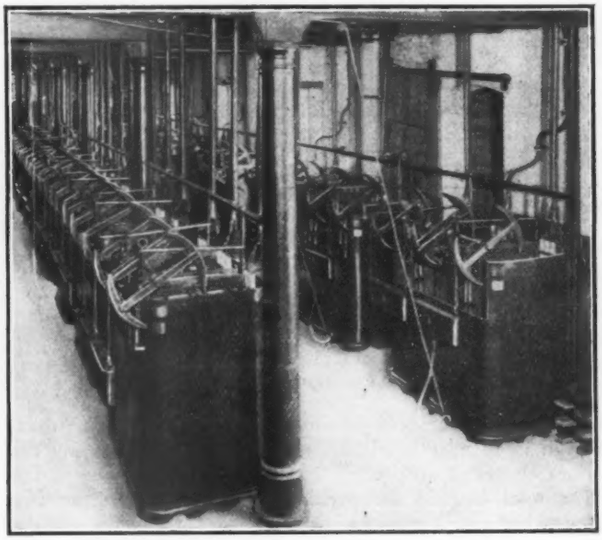


Fig. 6—Constant-Current Transformers.

split up into seven cells by six cross walls which extend not quite to the roof, each cell being large enough to hold a transformer and a 60,000-volt enclosed fuse holder.

For the convenience of operating, openings have been made in the partition wall separating the high-tension and low-tension compartments and over them fire doors have been hung to maintain the scheme of isolation. All the 60,000-volt air-break switches are mounted on a rack on the outside of the building, and are operated from a gallery built against the wall of the station 15 ft. above the ground.

The transformers are mounted upon carriages, and may be removed through large doors in the building wall which open

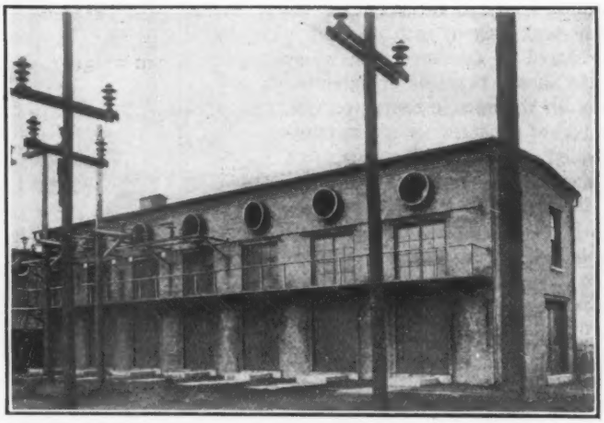


Fig. 7—The Solvay Substation.

out upon a permanent track, laid parallel with and extending the entire length of the station.

The low-tension compartment has two floors, the main floor and side walls providing space for busbars, disconnecting switches, service transformers and oil-circulating pumps. A gallery floor 12 ft. above, which spans the entire compartment, provides access to the lightning arresters and supports the cell-mounted, motor-operated, 11,000-volt outgoing line switches.

For cooling the transformers city water is used. But to render this an economical proposition, a cooling pond 20 ft. in diameter and 8 ft. deep, superimposed with a cooling rack of corrugated iron, is erected close by the station and forms a part of the water-circulating system.

The Syracuse Lighting Company purchases at the Solvay substation 5000 hp. It is utilized in the apparatus previously

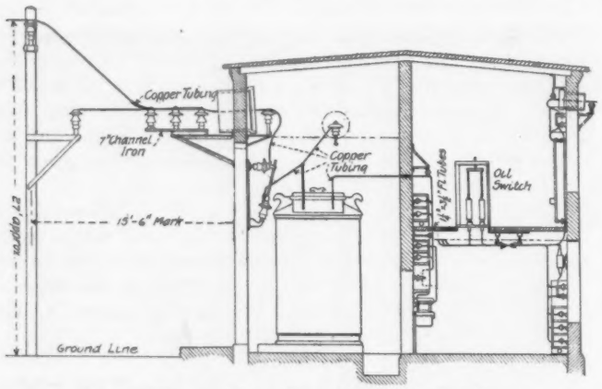



Fig. 9—Plan and Elevation of Solvay Substation.

described and located in the steam station at Syracuse, which are run in parallel with the steam-driven units to supply the various classes of service.

The total cost of the purchased energy is based on two charges, one a service charge per year per horse-power and the other a consumption charge per kw-hour, so that to obtain a minimum total charge per kw-hour the load factor on the purchased energy apparatus is maintained at a maximum.

The station has a load which is characteristic of lighting and motor service, and the steam units are called upon to carry only the peak load above 5000 hp, and therefore they are utilized but a few hours each day for this purpose. Throughout the remaining hours the steam plant is maintained ready to carry unexpected day peaks above 5000 hp, and is prepared to take over the whole load should there be an interruption of the outside energy service, thereby maintaining an uninterrupted service to the company's consumers.

Toward this end two 1500-kw turbines are floated on the 2300-volt bus, which when not required to furnish energy are used as synchronous condensers to improve the power factor and obtain a maximum energy output from the electrically operated machines. When purchased energy fails they naturally take over the load on the station at that time.

To make this method of operating successful, steam must be supplied abundantly upon short notice, and to maintain the steam plant in condition to do this, the most important problem of economical combined operation is presented, and it becomes particularly important in a station purchasing 85 per cent of its output and called upon only at rare intervals to generate its entire output from steam.

The maintenance of coal fires under boilers in such shape as to provide steam at short notice over long intervals is expensive, both as to coal used and labor employed; and, furthermore, as the period during which the standby boilers are required is usually short, the large amount of coal that is fired when the boilers are rushed into service makes excess steam that is blown off from the safety valves after the outside energy service is restored. This useless expense, together with the fact that it takes a relatively long time for a coal fire to put a boiler in good steaming condition, led to the installation of an oil-burning firing system and the equipment of eight boilers with oil burners.

These boilers, of course, must be kept hot and maintained at a pressure reasonably close to the normal operating pressure, and are so maintained with live steam drips from the Holly system, assisted by live steam turned into the boilers, below the water line, through injectors placed in the water legs. Under normal conditions, there are just enough coil-fired boilers making steam to carry the load on the station above 5000 hp, with the oil-equipped boilers standing by, hot, ready to make additional steam sufficient to carry the entire plant load. Gas pilots are kept burning at the ends of the oil burners, so that, when the demand is made for emergency steam and the steam-driven generators are called upon to carry the entire load, there is no delay in starting combustion.

This standby system has worked out very satisfactory, and the operating results have fully demonstrated its economy over coal-fired boilers used for the same purpose.

The property, for the past three years, has been owned and operated by The United Gas Improvement Company, of Philadelphia, and in that time there has been a continuous succession of improvements and extensions, the most important of which have been the installation of the purchased energy equipment and the present street-lighting apparatus. The electrical equipment and the steam turbines were furnished by the General Electric Company.

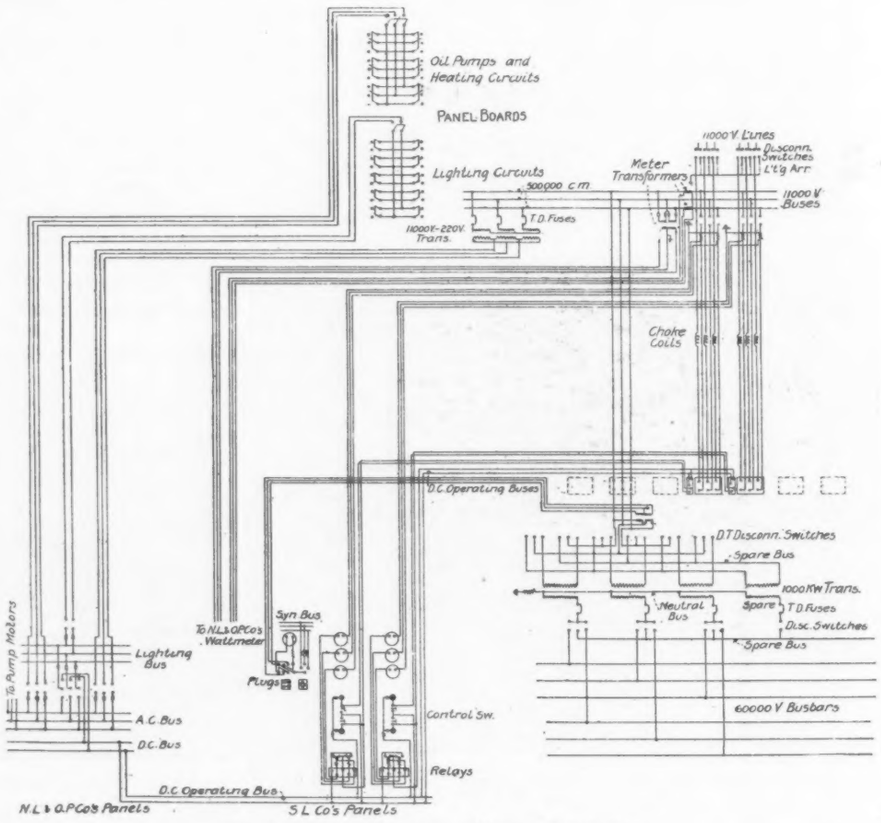



Fig. 8—Wiring Diagram of Solvay Substation.

## ENAMELED-WIRE WINDINGS.

By Charles R. Underhill.

THE aim of the engineer is ever toward the ideal—100 per cent efficiency. At present, there are several factors which prevent even a close approximation to the ideal in electromagnetic windings, one of which is the resistivity of the conductor itself.

It is obvious that, with a given allotted winding space for the insulated conductor, the thinner the insulating material used the greater will be the amount of conducting material contained in the winding space. In this case, the practical condition would be obtained when the winding consisted of but one turn of bare conductor, which might form a hollow cylinder.

Since, in practice, it is customary to use round copper wire insulated with some suitable material, it is obvious that the

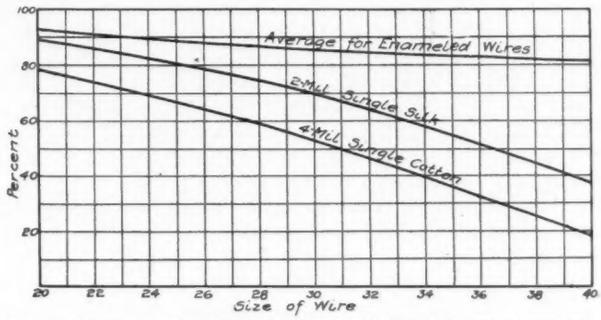



Fig. 1—Curves of Relative Activities of Wires Variously Insulated.

*activity* of the winding will vary directly as the ratio between the cross-sectional area of the conductor and that of the conductor plus insulation. Hence

$$a = \frac{d^2}{d_1^2} \qquad (1)$$

wherein $a$ is the activity, $d$ the diameter of bare wire, and $d_1$ the diameter of insulated wire.

It is to be noted that the activity for round wires is only $\frac{\pi}{4}$ of that for wires of square cross-section.

Prior to the introduction of enameled wire, magnet wires were commonly insulated with cotton or silk. In both cases the insulation acted largely as a spacer, silk being preferable, as its thickness was approximately only one-half that of cotton. For sizes above No. 20 B. & S., the thickness of the cotton wrapping was 2 mils (0.002 in.) making 4 mils total increase in the diameter of the insulated conductor over that of the bare wire. The average thickness of the silk was 1 mil (0.001 in.), making the total increase in diameter 0.002 in.

The thickness of the coating on enameled wires varies from approximately eight-tenths of a mil (0.0008 in.) for No. 20 wire, to fifteen-hundredths of a mil (0.00015 in.) for No. 40 wire. Fig. 1 shows the relative activities for single cotton, single silk, and enameled wires from Nos. 20 to 40 B. & S. inclusive, taking bare round wire as 100 per cent, and using the above insulation thicknesses.

An examination of Fig. 1 reveals some astonishing facts. For instance, a winding space of fixed dimensions which will contain approximately 2000 ohms of No. 40 single cotton covered wire, or 3800 ohms of single silk insulated wire, will contain approximately 8200 ohms of No. 40 enameled wire. The actual resistance for enameled wire would be 8700 ohms; 4.35 times as much resistance as may be obtained with 4-mil increase cotton insulation, and 2.3 times as much resistance as with 2-mil increase silk.

A simple method of calculating the resistance which may be contained in a definitely prepared winding space with a given size of wire is to ascertain the resistance per cubic inch for the insulated wire. The resistance of the winding will then, of course, be equal to the product of the winding volume in cubic inches times the resistance per cubic inch, or

$$R = V\rho_v, \qquad (2)$$

wherein $R$ is the resistance of winding in ohms, $V$ the winding volume in cubic inches, and $\rho_v$ the ohms per cubic inch.

The resistance per cubic inch is found by simply taking the product of the turns per square inch times the resistance per inch of length of the wire constituting the winding. These data may be found in the form of tables, or are easily calculated from the insulated-wire constants. Fig. 2 shows the turns per square inch. The ohms per inch are shown in Fig. 3.

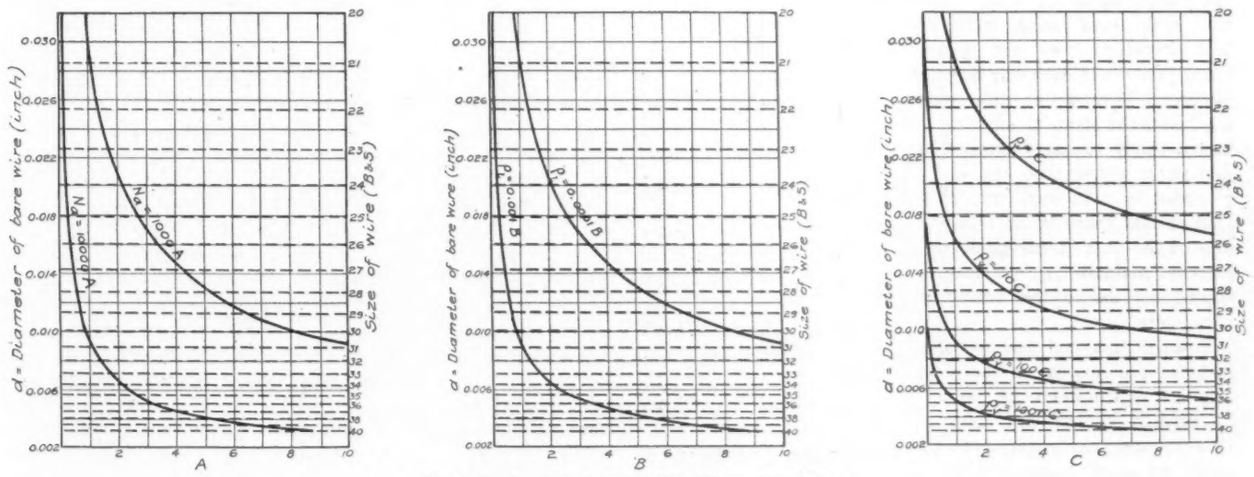
Now

$$\rho_v = N_a\rho_l \qquad (3)$$

wherein $\rho_v$ is the ohms per cubic inch, $N_a$ the turns per square inch, and $\rho_l$ the ohms per inch.

In Fig. 4 are given the values of $\rho_v$. Figs. 2 to 4 show values of constants for enameled wires from Nos. 20 to 40 B. & S., and for all diameters of copper wire from 0.003 in. to 0.032 in.

For a winding of fixed dimensions, wound with a certain size of wire, and with a given e.m.f., direct current, applied to its terminals, the ampere-turns will be constant regardless of the thickness of the insulation on the wire.




Figs. 2, 3 and 4—Insulated-Wire Constants.

CURRENT CONSUMPTION WITH DIFFERENT KINDS OF INSULATION.

| Insulation. | Relative amount of current consumed— No. 20 wire. | No. 25 wire. | No. 30 wire. | No. 35 wire. | No. 40 wire. |
|---|---|---|---|---|---|
| Four-mil increase cotton | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Two-mil increase silk | 0.89 | 0.85 | 0.71 | 0.63 | 0.52 |
| Enameled wire | 0.85 | 0.76 | 0.60 | 0.42 | 0.23 |
| Infinitesimal insulation (practically bare wire) | 0.79 | 0.67 | 0.50 | 0.35 | 0.20 |

For a fixed resistance, the current consumption will be the same in all cases, and the above figures will then represent the relative volumes of insulated wire required. The average

diameter of the turns will, therefore, decrease with the volumes, which causes the ampere-turns to increase as the volume of wire decreases. Fig. 5 clearly illustrates this. Here a winding the outside diameter of which is three times the internal diameter is taken as a standard for enameled-wire windings. The curves for silk and cotton insulation show the percentage of ampere-turns obtained with silk and cotton insulation, as compared with enamel insulation, the resistance and current consumption being constant for any given size of wire with the three types of insulation. The loss in ampere-turns for silk and cotton insulated wire is due to the greater diameter of the windings with those insulations.

Again, for a given winding space and current consumption, a larger cross-section of copper may be used in the enameled-wire winding than for silk or cotton covered wires. For instance, by combining (1) and (2),

$$R = V N_a \rho_l. \qquad (4)$$

Hence, for any fixed winding volume,

$$R \propto N_a \rho_l. \qquad (5)$$

Therefore, for constant resistance and fixed winding volume, the greater the value of $N_a$ (turns per square inch) the smaller will be the value of $\rho_l$ (ohms per inch).

As an example, consider the following:

| | | No. 36 wire. | No. 37 wire. | No. 38 wire. |
|---|---|---|---|---|
| $\rho_l$ | | 0.00345 | 0.00435 | 0.0055 |
| $N_a$ | Enamel | 31,800 | 43,400 | 54,100 |
| | Silk | 20,300 | 23,900 | 28,000 |
| | Cotton | 12,300 | 13,900 | 15,700 |
| $N_a \rho_l$ | Enamel | 110 | 188 | 298 |
| | Silk | 70 | 104 | 154 |
| | Cotton | 42.5 | 60.5 | 86.3 |

Thus a relative resistance of 100 may be obtained with No. 36 wire for enamel insulation, No. 37 wire for silk, and a

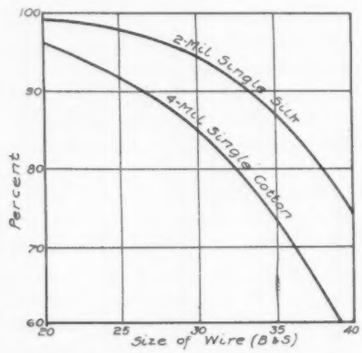



Fig. 5—Curves of Ampere-Turns.

wire between Nos. 38 and 39 for cotton. The relative ampere-turns for equal resistances and current consumptions will be, taking enameled wire as unity: Enamel, 1.00; silk, 0.80, and cotton, 0.60 (approx.).

Enamel insulation is non-hygroscopic, tough, elastic, and will withstand a temperature of 600 deg. Fahr. A good test for its adhesive qualities is to draw the enameled wire between the nails of the thumb and forefinger. The enamel should not come off.

The data given above show plainly that the space-factor of electromagnetic windings is rapidly approaching that for bare wires, and the further fact that the heat-resisting qualities of the insulation have been more than doubled, makes it possible to accomplish results hitherto unattainable.

## Spark-Gap for Wireless Telegraphy.

According to experiments made by Mr. C. C. F. Monckton on the reception of radiotelegraphic signals when transmitting with a spark-gap in compressed air, as compared with signals received when an ordinary spark-gap was used there appears to be no advantage in using compressed air for this purpose. While the dielectric strength of the air is enormously increased, so also is the resistance to the oscillatory spark, both appearing to increase at about the same ratio.

## MAGNETIC PROPERTIES OF MATERIALS.

At a recent meeting of the American Association for the Advancement of Science Prof. A. A. Knowlton presented a paper on the present state of knowledge of magnetic material in which the results of the foremost experimenters have been summed up and presented in concise form. Although the subject is one that is especially interesting to physicists it is also of great value to designing engineers and those desirous of keeping in touch with the advancement of theory important to practical engineering design.

The greatest interest centers about the magnetic quality of iron as affected by alloying with small quantities of other metals, such as aluminum, silicon and tungsten. These investigations have been carried on largely by various electric companies with a view to producing a superior grade of transformer iron. The addition of amounts of aluminum up to 5 per cent was found to improve the quality. A number of papers upon the properties of the other ferromagnetic metals, nickel and cobalt, have added detail to the knowledge of their behavior without giving any results of general importance.

By all means the most striking development in the field of ferromagnetics is Heusler's discovery that alloys may be made containing none of the metals usually spoken of as magnetic, which are, nevertheless, as strongly magnetic as cast iron and which exhibit all the phenomena of ferromagnetism, with the one important exception of the Kerr effect. It appears probable that the magnetic properties of these alloys are inherent in a certain crystalline structure, the magnetic crystals probably containing manganese-aluminum units imbedded in some sort of matrix which exerts an important influence upon their behavior. This, of course, indicates that ferro-magnetism is a crystalline rather than a molecular property—a view which is confirmed by work along other lines.

Besides the copper-manganese-aluminum alloys those of copper manganese with tin, arsenic and antimony are also ferromagnetic, but in a less degree. No attempts seems to have been made to replace the copper by any other metal, probably because the tendency has been to regard the copper as playing a relatively unimportant part in the phenomena—a view which is perhaps not wholly justified by the experimental work. Neither, to the knowledge of the writer, has any systematic search been made for a metal to replace the manganese in combination with trivalent metals.

The absence of the Kerr effect is a fact of very great importance. If true, and there seems no doubt that it is, we must suppose either that the cause of ferro-magnetism in these alloys is different from the cause of the same phenomenon in iron, or that the Kerr effect in iron is, in reality, an accidental, rather than an essential, accompaniment of the magnetism—two suppositions either of which appears inherently improbable.

The work of Kempken and Gans upon permanent magnets shows that a permanent magnet is the seat of a constant m.m.f. even when the reluctance of the circuit is increased by as much as 170 per cent, while under the same conditions the magnetic flux of such a magnet is a variable quantity. Such a magnet may thus be likened to a battery or a dynamo of constant e.m.f. whose current output is dependent upon the resistance of the external circuit. This result, which agrees with the assumption of Heavyside and is contrary to that of Abraham, constitutes our most important advance in this particular field. It would appear to point definitely to a system of electronic currents of constant value, and position as the cause of permanent magnetism, and, of course, a similar system, variable in position, must be the cause of the temporary magnetism induced by an external field. So far all attempts to reconcile this fact with the undoubted crystalline nature of ferro-magnetism have been to say the least, unsatisfactory.

A very striking illustration of the crystalline nature of ferro-magnetism is found in the mineral pyrrhotine (magnetic sulphide of iron, $Fe_7S_8$) which is strongly magnetic in one direction, but non-magnetic in directions at right angles to the first. The work of Maurin upon the magnetism of electrolytic iron

deposited in a magnetic field is also of great interest. He finds that after a layer of iron has been deposited upon a brass tube in a magnetic field a second layer deposited in a field of the same strength, but opposite in direction, is still magnetized in the original direction, the value of the intensity being about 85 per cent that of the original layer. When the strength of the reversed field is increased to nearly three times its original value there is an abrupt change in the sign of the magnetism of the deposit. Clearly one has here to deal with forces of very great intensity due to the structure of the crystals of iron already deposited, and it seems likely that these forces are of exactly the same nature as those which control the growth of a crystal of sugar in an over-saturated solution. Thus the arrangement of atoms in the crystal is, possibly, due to these crystal-building forces while the orientation of the magnetic crystal as a whole may determine the direction of magnetization.

Clifford has been the first observer since Faraday to obtain dia-magnetic copper, and has found that copper-tin alloys are more strongly diamagnetic than pure copper in spite of the para-magnetic nature of tin, thus establishing the existence in the diamagnetic field of a phenomenon analogous to that of the Heusler alloys in ferro-magnetics. Work with bismuth appears to indicate a difference in its diamagnetic quality dependent upon the orientation of the crystals in the field. Further work along this line, however, is greatly to be desired.

The relations of magnetism to other properties have been extensively studied. In the present state of our theoretical knowledge the great mass of data upon the subject of magnetostriction, to which the industry of Nagaoka and Honda has contributed so much, cannot be interpreted. The effect of a magnetic field upon electrical and thermal conductivities has been extensively studied by several observers who find an increased resistance in the transverse magnetic field for all para-magnetic and ferro-magnetic metals and a decreased resistance under the same conditions for diamagnetic materials. These results are doubtless closely connected with the Hall effect, and are as unexplainable in terms of our present simple electron theory as is that phenomenon itself. Concerning the effect of a magnetic field upon thermal conduction contradictory results have been obtained. Perhaps the best experiments appear to indicate the absence of such an effect, although one would naturally infer its existence because of the close connection between thermal and electrical conduction.

Mr. Knowlton is of the opinion that diamagnetism in all cases, except possibly bismuth and the copper and tin alloys of Clifford, is to be regarded as an atomic property as is also para-magnetism in the narrower sense of the term, while ferro-magnetism is undoubtedly neither atomic nor molecular, but crystalline. Indeed, it is questionable if the word molecule has in the present state of our knowledge any definite physical significance whatever when applied to matter in the solid state. There does not appear to be any evidence for the so-called molecular theory which will not apply equally well to prove that magnetism is a crystalline property.

Ultimately, of course, all magnetic phenomena must be due to electronic currents. The very beautiful hypothesis of Langevin (*Journal de Physique*, October, 1905) appears to account in quite a satisfactory manner for the phenomena of diamagnetism and para-magnetism, but throws little, if any, light on the more complicated ferro-magnetism. The cause of diamagnetism and para-magnetism must, in the opinion of Mr. Knowlton, be associated with some peculiar grouping of the ultimate particles (molecules in the chemical sense) of the material, whether it be an element like iron or a mixture as in the Heusler alloys. The phenomena of hysteresis are, on the other hand, probably due, in part at least, to the nature of the matrix surrounding the magnetic elements and to the constraints which this matrix exerts upon these magnetic groups. A comprehensive working hypothesis as to the precise nature of this structure is the greatest present need in this field.

## THE INDUCTION COIL.—II.

### Its Principles, with Oscillographic Diagrams to Illustrate Its Operation.

By Benj. F. Bailey.

In last week's issue were outlined the main features of primary and secondary induction coils and a discussion was given of the operation of the latter coil with the secondary loaded. The treatment below relates to the operation of the secondary coil when a condenser is connected across the break, and also to the performance of the high-frequency coil.

#### SECONDARY COIL WITH CONDENSER.

The circuit of a coil with a condenser is shown in Fig. 5. As was previously mentioned, this is the type of coil that is most frequently used. The condenser introduces some new and very interesting effects which will here be studied.

The condenser is the electrical analogue of the spring. In the spring there is produced a pressure proportional to the compression or elongation expressed by the formula $F = KD$ in which $K$ is the constant of the spring. Similarly, the formula of the condenser is $E = \frac{1}{C} Q$, in which $Q$ is the quantity of electricity and $C$ is the capacity or constant of the condenser.

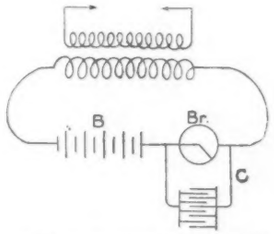



Fig. 5—Circuit of a secondary coil with condenser.

The mechanical analogue of a coil with condenser is a flywheel exactly the same as before, but to which at the instant corresponding to the break a spiral spring is attached instead of a brake. The driving motor is supposed, as before, to exert a constant torque, just as the battery in the coil circuit exerts a constant e.m.f. The displacement of the wheel from its position of rest corresponds to the displacement of electricity, is commonly called the quantity $q$. The angular velocity of the wheel, $d\omega = \frac{d\theta}{dt}$ is analogous to the current $i = \frac{dq}{dt}$ and the acceleration $a = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$ to the rate of change of current $\frac{di}{dt} = \frac{d^2q}{dt^2}$. At the instant that the spring is applied, the velocity of the wheel decreases, and it quickly comes to rest. The spring, however, has been compressed during the process, and the wheel consequently rotates the other way. It again comes to rest and starts back, and so continues to oscillate for some time; the oscillations gradually becoming weaker and finally stopping altogether.

In the electric circuit the action is exactly the same. The quantity of electricity $q$, the current $i$, and the e.m.f. all oscillate just as do the displacement, the velocity, and the acceleration of the wheel. Fig. 6 shows the oscillation of the current in such a circuit. The coil used was the same one as was used in taking the curves of Figs. 2, 3 and 4. The secondary circuit was open and, hence, had no influence. The oscillations would be quicker with smaller values of the capacity. A small capacity corresponds to a stiff spring, since the smaller the condenser (spring), the less the charge (displacement) required for a given e.m.f. (force).

The mathematical treatment of this case is somewhat longer, but not more difficult, than that of the previous ones. During the make the condenser is short-circuited and obviously exerts

no influence. All that has been said regarding the secondary coil without condenser applies without change. During the break, however, it has a decided effect, especially if little or no current is being taken from the secondary.

The differential equation is the same as that at the make, with the addition of a term to express the difference of potential over the condenser. It may be stated thus: Battery e.m.f. = Back e.m.f. of the condenser + back e.m.f. due to inductance + drop due to resistance. It is, however, more convenient to express the equation in terms of $q$, the quantity of electricity,

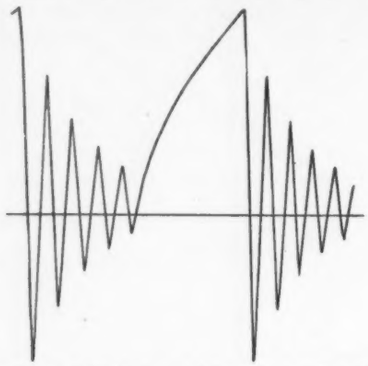


Fig. 6—Current at break in a secondary coil with condenser (unloaded).

rather than in terms of $i$, the current, since the use of the latter would require the use of an integral to express the difference of potential over the condenser.

The fundamental equation is then $E = L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{c}$

To avoid needless difficulties the solution will be given at once, and it will then be shown that it satisfies the original equation. The result is: $q = Q \cdot \epsilon^{-\frac{Rt}{2L}} \sin \sqrt{\frac{1}{CL} - \frac{R^2}{4L^2}} \cdot t + Q.$

This is the equation of a curve of the form of the oscillating part of Fig. 6. The general form might have been anticipated. It consists of a quantity $Q$ multiplied by a sine function, thus indicating an oscillation. The value of this sine function is progressively reduced by a factor $\epsilon^{-\frac{Rt}{2L}}$ which is equal to 1 at $t = 0$ and gradually becomes less as $t$ increases, reaching nearly zero in a short time. The last term $Q$ represents the quantity of electricity that remains in the condenser after the oscillation has entirely ceased. It corresponds to the displacement of the spring and wheel from their position of rest, due to the constant torque of the motor. This, it will be remembered, was assumed to be acting continually.

To show that the above is a solution of the equation, it is necessary merely to take the first and second differentials of $q$ with respect to $t$ and substitute in the original expression. This is not at all difficult, but is rather long and, hence, will not be given here.

In most cases a great simplification of the expression is possible. The terms $\frac{1}{CL}$ and $\frac{R^2}{4L^2}$ occur as an algebraic difference, and the latter is usually very small compared with the first. Thus, in the case of the coil used in taking these curves, $R = 1$ ohm and $L = 0.01$ henry, and $C$ was 1.0 microfarad, or 0.000001 farad. Thus, $\frac{1}{CL} = 100{,}000{,}000$, while $\frac{R^2}{4L^2} = 2500$, or the former is about 40,000 times as great as the latter. Hence, it is entirely allowable to neglect the term $\frac{R^2}{4L^2}$. By doing so there is obtained, $q = Q\epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}} + Q.$

The expressions for the current and e.m.f. are readily derived, since $i = \frac{dq}{dt}$ and $e = L\frac{dq^2}{dt^2}$

hence, $i = \frac{Q}{\sqrt{CL}} \epsilon^{-\frac{Rt}{2L}} \cos \frac{t}{\sqrt{LC}} = I_b \epsilon^{-\frac{Rt}{2L}} \cos \frac{t}{\sqrt{LC}}$

and $e = -\sqrt{\frac{L}{C}} \cdot I_b \cdot \epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}}$

The rate of oscillation of each of these quantities is obviously the same. The period is readily obtained if it be considered that in one wave the angle increases from zero to $2\pi$. Hence, calling $T$ the time of one complete vibration, $T = 2\pi\sqrt{LC}$. From this formula one can readily compute the time of one wave. Thus, in the case of the coil used here,

$$T = 2\pi\sqrt{0.01 \times 0.000001} = 0.000628,$$

or about $1 \div 0.000628 = 1510$ complete waves per second.

The expression for the secondary e.m.f. is readily derived. If the magnetic leakage is small; it is in the same proportion to the primary e.m.f. as their respective turns. Hence, it is given by

$$e_s = -\frac{N_s}{N_p}\sqrt{\frac{L}{C}} \cdot I_b \cdot \epsilon^{-\frac{Rt}{2L}} \sin \frac{t}{\sqrt{LC}}.$$

Fig. 7 is a curve taken under the same conditions and with the same coil as Fig. 6, but showing the secondary e.m.f. in addition to the primary current. The coil was practically unloaded, only enough current being taken from it to operate the vibrator of the oscillograph. It will be noticed that the maximum e.m.f. occurs at the time of zero current. This is the case since the rate of change of the current is greatest at this point. It is indicated in the mathematical expression by the fact that the current curve is a cosine function while the e.m.f. curve is a sine function.

If only the first wave of e.m.f. be considered its maximum height occurs a very short time after the break, hence the term $\epsilon^{-\frac{Rt}{2L}}$ is very nearly equal to unity, and the maximum secondary e.m.f. is given by the expression $e_{sm} = -\frac{N_s}{N_p}\sqrt{\frac{L}{C}} \cdot I_b$. It is proportional to the ratio of the secondary to the primary turns, to the current at break, to the square root of the inductance divided by the capacity. This value is of great importance in the majority of cases, since an induction coil is usually employed to produce a spark, and this is the value of the e.m.f. available for forcing the spark across the gap.

It appears from this expression that, with a given coil, the

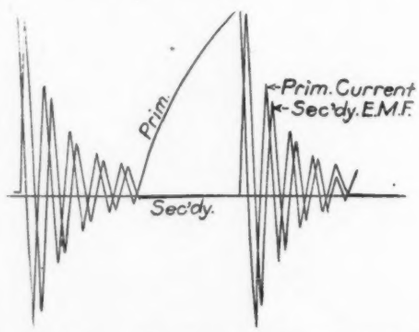



Fig. 7—Curves of current and e.m.f. in an unloaded secondary coil with condenser

less the capacity the greater the secondary e.m.f., and hence the greater the sparking distance. This is strictly true for large values of the capacity. If an attempt is made to use too small a capacity, sparking will occur at the break. Thus, there will be a loss of energy, and the secondary e.m.f. will be less than the above expression. In fact, if the capacity be too greatly reduced, the e.m.f. will be reduced instead of increased. The writer has published elsewhere a series of curves showing this action very plainly. No general rule can be given regarding the best value of the capacity to use. It depends largely upon the character of the break employed. With a very rapid break, small capacities, or even none at all, may be used, and very

high secondary e.m.f. may be secured. An example of this kind of break is the Wehnelt interrupter.

When a secondary coil is "loaded" by attaching the secondary terminals to a suitable receiving circuit, the action is very materially changed. If the resistance is non-inductive the effect is to damp out the oscillations to a large extent. To return to the analogy of the flywheel, it is as though, in addition to interposing a spring (corresponding to the introduction of the condenser in the case of the coil), a brake were also

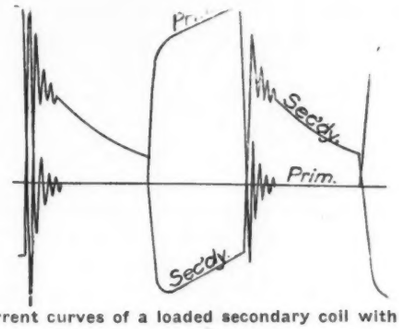



Fig. 8—Current curves of a loaded secondary coil with condenser.

suddenly applied. The brake corresponds to the resistance inserted in the secondary circuit. It is evident that if the friction of the brake be great enough, the wheel will come to rest without oscillations. If, on the other hand, only a small amount of friction be applied, the wheel will make a greater or less number of oscillations before coming to rest. The same is true of the coil. Fig. 7 shows a case in which the resistance used was very great. Hence, the damping effect was slight; in fact, the oscillations were of almost exactly the same amplitude and frequency as in the case of Fig. 6 where the resistance was infinite.

In Fig. 8, on the contrary, the resistance was small, so as to take a considerable current from the coil. The strong resemblance between Fig. 8 and Fig. 4 will be at once apparent. Some oscillation is, however, still present in both the primary and the secondary. That this is so is due to the fact that not all the lines that pass through the coil cut both the primary and the secondary. The condenser, with the local inductance of the primary, constitutes an oscillating circuit. The self-induction of the primary is small, since it is due to the lines which pass through the primary only. Hence, the rate of oscillation is high. This condition explains in a general way the high-

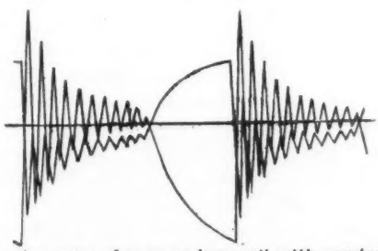


Fig. 9—Current curves of a secondary coil with condenser. Inductance in secondary.

frequency oscillations of the primary in Fig. 8. The oscillations in the primary react upon the secondary, producing an oscillation superimposed upon the logarithmic current curve.

In Fig. 9 this effect was purposely intensified by connecting an inductive resistance in the secondary.

### APPLICATION TO PRACTICAL COILS.

By making use of the principles and formulas previously deduced, it is possible to compute the output per spark, maximum voltage, frequency of oscillation, etc., of any induction coil. To do this in the case of a coil already built, requires the taking of a few simple measurements. These may be made in various ways. The methods here described are perhaps as simple as any.

The capacity of the condenser is ascertained by disconnecting the condenser from the coil, and connecting it to a source of alternating current. A suitable ammeter should be in circuit and a voltmeter across the terminals of the condenser. The frequency of the circuit is usually known with sufficient accuracy, or it may be ascertained by observing the speed of the alternator. This will, however, usually be unnecessary. The capacity in farads will be $C = \frac{I}{2\pi f E}$ where $I$ is the current in amperes, $E$ is the voltage, and $f$ is the frequency in cycles per second. The capacity in microfarads will be 1,000,000 times as great. The value in farads is, however, the one to be used in the formulas.

The inductance of the coil is determined by connecting the coil (without condenser), a resistance and an ammeter in series to the alternating-current mains. A voltmeter is also to be connected across the terminals of the coil. The value of $L$ in henrys is $L = \frac{E}{2\pi f I}$. This neglects a slight correction for the resistance of the coil, but is sufficiently accurate for most purposes.

To ascertain the value of "$i$," the current at break, the procedure used will depend upon the type of break employed. If the break is mechanical, the time of contact should be determined. This is readily done by measuring the arc of contact, and the rate of revolution of the driving mechanism. The current is then computed from the formula

$$i = E/R\left(1 - \epsilon^{-\frac{Rt}{L}}\right).$$

The values involved are those that have just been determined.

If, on the other hand, a vibrator is used with the coil, the simplest procedure is to connect the coil, a few cells of battery, a resistor of variable resistance, and an ammeter in series. The resistance should be gradually reduced until the vibrator just starts to operate. The largest value of the current that can be passed through the coil without causing the vibrator to open is approximately the value of "$i$." When the coil is in operation the current may rise to a slightly greater value on account of the inertia of the vibrator. It is believed, however, that the value as above determined will be very nearly correct, at least for light vibrators. It is obvious that using the formula just given, since all the values except that of $T$ are known, one can readily compute the time that elapses from the closing of the circuit until opened by the vibrator. This value may be useful, for example, in the case of a coil employed to ignite the charge of a gasoline engine, since it shows the designer the amount of angular advance necessary to allow in the timer in order to insure the passage of the spark when the engine is on the dead center.

Having the above data one can readily compute the electrical characteristics of the coil. Maximum output per spark $= \frac{1}{2} L i^2$. This is, strictly speaking, the output one would get if there were no loss in sparking at the break and no loss in the iron core. The actual output will be about 20 per cent less. This output will be expressed in joules.

The power output in watts is given by the product of the joules per spark, as just obtained, and the number of sparks per second. This value may be of importance in the case of coils that are used continuously for long periods. In such cases the output of the coil may be limited by heating, and a consideration of this value might be necessary to determine the possibility of using the coil for a specified service.

The e.m.f. of the secondary at make is given by the expression $\frac{N_s}{N_p} \cdot E$, where $E$ is the e.m.f. of the battery or other source of energy. The ratio $\frac{N_s}{N_p}$ is usually known from the construction of the coil. In case it is not so known, it may be determined by connecting either the primary or the secondary

to an alternating current line, and measuring the ratio of the two voltages.

The maximum e.m.f. at break is given by the expression $e_s = -i\frac{N_s}{N_p}\sqrt{\frac{L}{C}}$. It must be remembered that this is the value obtained on open circuit. If current passes in the secondary, the value will be somewhat less. Likewise, if the condenser is of insufficient size to prevent sparking at the break, the voltage obtained will be less.

The frequency of the oscillation is determined by the equation

$$f = \frac{1}{2\pi\sqrt{LC}}$$

### THE HIGH-FREQUENCY COIL

While perhaps not an induction coil in the ordinary acceptance of the term, the principles upon which these coils operate are almost precisely the same as those just explained. These coils are used in wireless telegraphy, in electrotherapeutics, for providing excitation for X-ray tubes and for many minor uses.

The circuit of such a coil is shown in Fig. 10. The source of charging current is usually a transformer, stepping up the voltage of an alternating-current circuit to from 5000 to 10,000

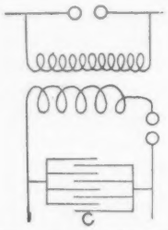



Fig. 10—Circuit of a high frequency coil.

volts. Its place may, however, be taken by an induction coil or by a static machine. The power output will, however, usually be greatest with a transformer. The action is as follows. The transformer or other source of current gradually charges the condenser. As it does so, the voltage over the condenser terminals rises, until the pressure is sufficient to force current across the spark-gap shown. As soon as this action takes place, the resistance of the gap drops to a very low value and the condenser discharges an oscillatory current through the primary of the coil. This current produces an e.m.f. in the secondary of the same frequency and usually of a greater voltage.

The values of the capacity and the inductance are so chosen as to cause the frequency of this discharge to be very high. Thus, in the case of one particular coil, the primary has only five turns of wire and the secondary two hundred turns. The inductance of the primary is 3.15 millionths of a henry. The condenser consists of a few sheets of tin-foil between glass plates, and has a capacity of 0.0425 microfarads. Using the formula $T = 2\pi\sqrt{LC}$, the frequency is found to be 435,000. This enormous frequency leads to many very beautiful and interesting effects, which time will not permit of describing here.

The output per spark in joules is readily figured. Neglecting losses, it is equal to $\frac{1}{2}CE^2$, where $C$ is the capacity of the condenser in farads, and $E$ is the voltage across its terminals at the instant of discharge. With 5000 volts applied, if the gap is so set that the discharge occurs at the top of the wave, $E$ will be $\sqrt{2} \times 5000 = 7070$ volts. The energy per spark is, therefore, $\frac{1}{2} \times 7070^2 \times 0.0000000425 = 1.06$ joules. The output, if current is supplied at 60 cycles per second—that is, 120 charges per second—will be $1.06 \times 120 = 127$ joules per second or $= 127$ watts.

At the instant the discharge starts there is an e.m.f. of 7070 volts across the primary, and consequently a secondary e.m.f. of approximately $40 \times 7070 = 280{,}000$ volts.

The above calculations are not exact, since on account of the very high frequency, certain secondary actions become of importance. For example, at the great frequency and voltage, even a very small capacity will take a considerable current. Hence, in an exact theory the capacity of the secondary could not be neglected. The limits of this article will not permit consideration of these points.

## ELECTRIC DRIVE IN MACHINE SHOPS.

A combined meeting of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers was held in New York on April 12. The subject of the meeting was the electric drive in machine shops, four papers dealing with this subject being read and discussed.

Mr. A. L. De Leeuw presented a paper devoted to the economics of the motor drive for machine tools. The author classed the savings effected by driving a shop electrically under the heads of increased output and less expense. Increased output results from the flexibility in speed control of the electric motor. However, there are other reasons why a change from belt to electric drive may increase the output of a machine. The electric drive may enable one to place the machine in a more convenient position, or bring it under a crane; or it may be the means of giving the machine more power than it could have with a belt drive; or again, it may be the means of doing away with some harmful conditions which have diminished the machine's efficiency. Among such circumstances may be mentioned the slackness of belts due to weather conditions, or to the varying loads placed on an upper floor, making the belts from pulleys attached to the under side of this floor either too loose, having been adjusted at a time when the load on the upper floor was light; or too tight, owing to adjustment at a time when the load on the upper floor was heavy. Then there is the convenience of altering speed if a machine has a motor or a convenient gear drive, when the operator might forget that there is such a thing as a change of speed for varying conditions of work, if he had to shift a belt. An almost unlimited number of considerations affect the result to be obtained from the application of a motor to a machine tool; so that it is almost impossible to forecast the economy which will result from such a change, though it may be perfectly possible to say that the change will be beneficial to some extent.

Mr. Charles Fair read a paper pointing out the fundamental principles underlying motor applications to machine tools, with special reference to speed-controlling arrangements. He stated that shunt motors are used where the work is of a fairly steady nature, where considerable range of adjustment of speed is required, and on group and line-shaft drives. Compound-wound motors are used where there are sudden calls for excessive power of short duration, as on planers, punch presses, etc. Series motors should be used where speed regulation is not essential and where excessive starting torque and slow starting speeds are required, as, for instance, in moving carriages of large lathes, in raising and lowering the cross rails of planers and boring mills, and for operating cranes.

When in doubt as to the choice of compound or series motors of small horse-power, the choice might be determined by the simplicity of control in favor of the series motor. Series motors, however, should never be used when the motor can run without load, as the speed would accelerate beyond the point of safety.

The alternating-current motor of the squirrel-cage type corresponds to the constant-speed, shunt, direct-current motor, but with a high-resistance secondary it approaches more closely the characteristics of a compound direct-current motor.

The slip-ring induction motor with external secondary circuit resistance would be used for variable speed, but this must not be construed to mean that it corresponds to a direct-current, adjustable-speed motor; it has the characteristics of a direct-current shunt motor with "armature control." The self-contained, rotor resistance type would be used for lineshaft drives, and for groups when of sufficient size.

Multi-speed, alternating-current motors are those giving a number of definite speeds, usually 600 and 1200, or 600, 900,

1200 and 1800 r.p.m., and are made for both constant horsepower and constant torque. These motors would be used where alternating current only is available, or direct current limited; the speed range of the motor, together with one or two mechanical speed-changing gears, would give the required speeds.

Equally important with the choice of motors is that of controlling devices. In selecting the control apparatus it is necessary to consider the nature of the work, its accessibility to the operator, the method of attachment to the tool and in some cases the relative position to other tools; for instance, an open-type starting rheostat should not be exposed to danger of short-circuit from flying chips. In the majority of cases, a shunt motor of ¾ hp and less would be started by a switch. Exceptions to this would be motors on tools that must be gotten under way slowly, and grinders driven by direct-current motors for reasons of safety. Series motors up to 8 hp or even larger can be started by means of a simple switch. Exceptions to this would be motors for cranes and tools requiring a certain amount of speed regulation. Larger motors, for tools where starting service is infrequent or not severe, and for lineshafts and for group drives, would be satisfactorily operated with a dial-type controller, which is cheaper than the drum controller, provided, however, that the controller is placed in a protected position.

When making the installation, accessibility to the controller in case of accident should be kept in mind, even though of little importance so far as starting up is concerned. The starting apparatus should be placed where the motor or some of the moving parts can be seen by the operator. On individual motor-driven tools, where the motor is started and stopped many times a day or where the starting conditions are of a severe nature, or where tools are edged along, drum-type controllers with extra heavy starting resistors should be used. For adjustable-speed motors, using the drum-type controllers, the field circuit should be through fingers making contact on segments of the controller drum and not by sliding contacts on a dial. Motors above 50 hp, under these severe conditions, are best operated by a master controller which operates contactors for cutting out steps of the starting resistor. This class of starting apparatus will withstand any quantity of abuse and, by the addition of a simple current-limit relay device, becomes practically a fool-proof protection for the motor. There are cases where it might be advantageous to use master controllers and contactors even with smaller motors.

Alternating-current, squirrel-cage, rotor-type motors, two-phase and three-phase, up to 8 hp, generally speaking, can be connected directly to the line, depending largely upon the service conditions. Above 8 hp they should be started by auto-transformers. The self-contained rotor-resistance type would be started by a sliding resistor in the rotor, and the slip-ring type by a controller with external resistor.

Upon the convenient arrangement of the controlling apparatus depends, to a considerable degree, the output of the tool, and the importance of the arrangement from the standpoint of the operator cannot be ignored, since the output of a tool will be materially increased when an operator can start and stop the tool and obtain at all times maximum cutting speeds by simply turning a handle. The controller must be placed in a safe position and should be accessible for repairs, which very often means that some arrangement must be used to bring the controller handle within easy access of the operator.

Much information concerning the power actually used by motors in driving machine tools was given in a paper by Mr. Charles Robbins. The information was based largely on the charts made by recording meters placed in the circuits of motors operating under various specified conditions.

An accurate knowledge of the operating conditions of all machine tools enables one to select the most advantageous electrical equipment, as well as the best machine-tool equipment, with suitable tools for different sets of conditions. An increased output may often be obtained with the proper equipment by reason of a more flexible arrangement of tools; greater facilities for handling materials at the tools; greater facilities for handling materials between tools; better facilities for obtaining auxiliary material, drawings, tools, etc.; better facilities for making adjustment of the tools during machinery operation, and removal of causes of unsuspected or avoidable delays due to small accidents and improper characteristics of the drive. Moreover, all lost time, due to whatever cause, and which can be avoided, is immediately brought to the attention of the superintendent, and an analysis of these losses will result in their elimination.

With motor-driven tools an analysis of the conditions can be made much more conveniently and with less expense than can similar studies with any other form of machine-tool drive. While in many shops there are elaborate systems of time keeping, with time clocks, etc., all of which are based on keeping an exact record of the workman's time and seeing that he works the maximum or full shop time, yet the most important consideration in manufacturing with machine tools is that the tools shall operate continuously at full load, on account of their greater hourly value.

A careful analysis and study of conditions which are conveniently possible in motor-driven establishments will greatly reduce the cost of operation. Wherever tests have been made with recording meters the conditions of operation have been very materially benefited, and many dollars have been saved on account of the knowledge shown by simple records taken from motor-driven machines, which records are available to all those who have the meters.

A paper by Mr. John Riddell was devoted to the mechanical features of electric driving in machine shops, with particular reference to the machine tools in the Schenectady plant of the General Electric Company. In this plant there are 8500 machine tools, of which 8150 are individually motor driven. Group driving has been adopted for some sensitive drills, speed lathes, and other small miscellaneous machines. Of the above tools there are 48 portable machines, consisting of slotters, milling and drilling machines, radial drills, etc. These machines are operated on 32,675 sq. ft. of iron floor plate, in addition to which there are 7000 sq. ft. of iron rails, cemented into the floor, for erecting purposes. If use were made of lineshafts, countershafts and belting there would be about 34,570 ft. of lineshaft, or about 6½ miles, and about 4¾ miles of countershaft which would require about 21,225 hangers and bearings. Allowing two belts to each machine, with an average length of 25 ft. per belt, there would be for the 8500 machines a total of 425,000 ft. of belting, equal to about 80½ miles.

### DISCUSSION.

In opening the discussion on the four papers of the evening Mr. Henry Hess remarked that the duty of the electric motor is merely to receive energy from the generator and produce the required rotative motion at the machine in the shop. Thus the generator, the transmission lines and the motor act as substitutes for the line shafting used in engine-driven machine shops. He claimed that a well-designed line of shafting equipped with ball bearings is much more satisfactory and economical for machine-shop driving than is any possible electrical equipment.

Mr. L. R. Pomeroy stated that for many uses in machine shops the induction motor is far preferable to the direct-current motor. By using suitable mechanical gearing for speed variation the constant-speed feature of the induction motor becomes not only not disadvantageous, but really advantageous.

Mr. Gano S. Dunn expressed the conviction that the basis used by Mr. Hess for comparing line shafting with electric drive is wrong. In the operation of a machine shop only about 2 per cent of the cost represents the energy consumed by the machines. The advantages of electric drive do not relate to saving in energy cost, but in other very conspicuous improvements over line shafting and belting.

Mr. Fred. L. Eberhardt explained the standardization work being done by the motor manufacturers and the machine-tool builders which promises to result in much benefit to the users of motor-driven machine tools.

Mr. De Leeuw explained that the machine-tool manufacturer, being in ignorance of the exact use to which each machine will be put, equips it with a motor of such a rating that it can withstand continuously the heaviest load that may be placed upon the tool. As a result of this policy the motors are much underloaded in many cases.

# Central Station

## Management, Policies and Commercial Methods

### BROOM-MAKERS MENACED BY SHADOW OF VACUUM CLEANER.

The passing of the old-fashioned broom in favor of the modern electrically driven vacuum cleaner is foreseen and was alluded to by speakers before the National Broom Manufacturers' Association, which held its annual convention at the Palmer House, Chicago, April 12. The broommakers admit that the vacuum cleaner is destined to become a part of the domestic equipment of every American household, and showed evidence to prove that as the price of these useful appliances becomes lower through improved design and methods of manufacture, the cost of brooms is destined to rise on account of the failure of farmers to plant sufficient broom corn to supply the demand for the straw.

### COST OF WATER PUMPING.

Central station companies which are figuring on the cost of pumping city water for water-works purposes will be interested in the following figures which apply to the cost of pumping the water for the city of Ellsworth, Wis. The city buys three-phase energy from the central-station company. A 10-hp motor operates a deep-well pump, which lifts water 40 ft. from the well to the standpipe of the water works. The pump has a differential plunger 4.5 in. in diameter by 24-in. stroke. The differential cylinder arrangement divides the work so that it does not all come on the up stroke of the plunger. The water pumped is measured by a meter. The cost to the city at the rate of 4 cents per kw-hour is 8.25 cents per 1000 gal. The consumption of energy is 2062 watt-hours per 1000 gal.

### "GALENA'S BRIGHT SPOTS—WATCH 'EM GROW."

An energetic central-station manager in a small city of the central West, where electric service was installed only a year ago, has adopted the following window display to show the townspeople how electric light is "taking on" in that town. In a large blue-line blueprint map of the city, the original of which was prepared by the engineering department for other purposes, he has punched small round holes, 1/8 in. in diameter, locating each customer on his lines. The map is then backed up by white tissue paper and the whole enclosed in a deep box frame in which electric lamps are enclosed. The resulting display shows bright circles of light for each customer, while the map itself is illuminated by transmitted light sufficiently to reveal the street outlines and names. The map is constantly kept up to date by adding punchholes for new customers, and at the top is the illuminated legend: "Galena's Bright Spots—Watch 'Em Grow."

### INCREASE BUSINESS FROM THE TUNGSTEN LAMP.

The South St. Paul (Minn.) Electric Light, Heat & Power Company has found the tungsten lamp an excellent means of increasing its business. In one case a customer who had complained of high bills and poor light, and finally threatened to put in a gasoline plant, was induced to try the tungsten lamp. He had 12 16-cp carbon lamps, with a monthly bill of between $3 and $4. He was advised, in order to secure a superior illumination, to install six 100-watt tungstens in his place of business. Although his bills for the next two months were $9.78 and $10.34 respectively, he was so much pleased with the improved illumination that no complaint was made as to the larger bills. It has also been found that consumers keep tungsten lamps turned on longer both mornings and evenings, preferring to obtain the benefit of the higher efficiency of the lamp in the form of more light.

### EXPERIENCE WITH A PRODUCER GAS ENGINE PLANT.

Mr. Alfred Horne related experiences with gas producers and gas engines at the plant of the Municipal Lighting Plant at Fairmont, Minn., at the recent convention of the Minnesota Electrical Association, held at Minneapolis. The Fairmont plant was described in the *Electrical World* of Dec. 19, 1908. It consists of two 160-hp suction producers, one 80-hp single-cylinder engine, one 160-hp twin engine, with one wet and one dry scrubber between the producers and engines. The plant was started on Oct. 23, 1907. Experiences were strenuous when the plant was first started. A man from the factory was on the ground for six or eight weeks. Trouble would be experienced every two or three days, and sometimes two or three times a day. After the factory expert left the operators began to watch the plant a little more closely in an endeavor to learn the actions of the engines under certain conditions. It was found that the plant could not operate when the producers were clinkered. It seemed difficult to start the engines in many cases. The gas would be so poor that it would not ignite, and then if the clinkers were taken out and a large amount of fresh coal put on, the gas was so rich that it would also cause trouble. At first the producers had to be changed every two or three weeks. They would get clinkered so badly that it was impossible to force a poker down to the grate. The fire would creep up into the producer until it would get so near the top that scarcely enough coal could be used to make a good gas.

It was found that one trouble was poking the fires altogether too much. Frequent poking packs the ashes and clinkers so hard in the bottom that it is almost impossible to get them out. The present practice is to poke fires once an hour, and then simply to pass the poker down three or four times at every poke hole. Once a day, when the producers are cleaned, the walls are given a thorough poking so as to loosen any clinkers that may have adhered to them. One producer has now been operating for two years continuously, 24 hours a day, and is in as good shape as on the day started. A second producer was started up during the past winter to operate in connection with the other producer. It was found that it took about 200 lb. of coal per day more to operate with two producers than with one. However, the engines worked better under a heavy load on two producers. This would indicate that the producers are over-rated for the best service. Each day when the producers are cleaned out they are filled up with fresh coal, and the steam is turned off so as to give the fire a chance to burn up well into the fresh coal before starting the larger engine for the peak load. Then a gas is obtained that is near normal.

The wet scrubber is filled with coke. It should be cleaned once a year, for by that time there is a heavy deposit of tar on the coke, which has a tendency to shut off the passageways for the gas. The dry scrubber is filled with excelsior, and it is found that this should be cleaned about three times a year.

Mr. Horne reports not having much trouble with the equipment now, except from preignition at nearly full load, when

trouble is manifest by a sort of rumbling. He cannot account for this trouble, unless it is due to high compression. It is, of course, natural that when the engine is carrying a heavy load it will take in a heavier charge of gas and the compression becomes higher. As the compression rises there is more liability for pre-ignition. He thinks one may expect a little more trouble with a gas-engine plant than with a steam plant. However, he believes that the gas engine will be brought to a very satisfactory point in the near future, and that every purchaser of generating equipment should give the gas engine a thorough investigation before he decides to purchase some other type.

Possibly with a pressure gas system one would not experience the sudden changes in gas that come in the case of a suction plant, and there may not be quite so much trouble from leaking valves in the engine. It is essential to keep these valves in good shape. The exhaust valves make the most trouble. With a leaking exhaust valve sometimes it is very hard to get the engine started.

In a little over two years $400 has been paid for repairs and extras on these engines. The first cost of the plant erected was $66 per horse-power. However, one must figure the cost of operation as well as first cost. The gas engine has had a hard fight on account of its high first cost, and the troubles that have been experienced with the engine in its early development caused by inexperience. In many instances the trouble was due to the producers being too small. A great deal of trouble has also come about through poor coal.

At Fairmont care is exercised in the selection of coal and poor coal is screened before it is used. It is a good plan to screen all the coal before it goes to the bin, as this can easily be done. During the month of October, 1909, the output of the plant was 24,705 kw-hours, and the coal consumption was 46,375 lb., or 1.87 lb. of coal per kw-hour. This coal costs $5.95 per ton, so the coal cost per kw-hour would be $.0056. This was while operating on one producer. During the month of December, while operating on two producers, the output was 30,863 kw-hours and the coal consumption was 60,125 lb., or 1.94 lb. per kw-hour. The figures were obtained by voltmeter and ammeter readings and represent kilovolt-amperes rather than kilowatts. The power-factor of the load is unknown. During the day the load was mainly motors, and in the evening almost entirely lighting.

In answer to some questions Mr. Horne said that some of the amount spent for repairs was for extra parts which had not yet been used. As to labor required to operate the plant two men are employed during the afternoon and until midnight. After midnight one man runs the plant. On the whole, he thought this about the amount of labor which would be required for a steam plant of similar rating. When the engine exhausted direct in the atmosphere, at first, the noise was very annoying. Later a cell was built into which the exhaust was discharged with much reduced noise. Except for the first two weeks there has been no expert in attendance at the plant.

Mr. Adolph Wagner said that many of the troubles experienced in the plant were overcome by the later improved apparatus. A similar plant recently started at Huron, S. Dak., is operating very smoothly and without trouble. There is not now the difficulty in getting good men that formerly existed. He mentioned a case of bad foundation causing shaft breakage in engines of this type. Fixing the foundation had removed the shaft trouble. Although he had made no test, he did not doubt that the engines of the Huron plant would come well under the maker's guarantee of 1.25 lb. of coal per hp-hour. With incompetent help he did not doubt that there would be more trouble than with a steam plant. The company formerly ran a steam plant requiring four men, which steam plant had been shut down and the gas-engine producer plant is operated with three men.

## GROUNDING OF SECONDARIES.

At the Minnesota Electrical Association convention, held at Minneapolis in March, Mr. Fred G. Dustin, chief electrical inspector of the city of Minneapolis, presented a very interesting paper on the grounding of secondary circuits. He said that from the underwriters' viewpoint, the word "safety" means freedom from fire hazard. Central-station companies are concerned with having their electrical equipments safe both as regards life and property. For many years it has been the practice to ground the neutral wire of three-wire, direct-current systems of distribution. In recent years there has been evolved a similar system of three-wire distribution from the secondaries of constant-potential transformers. The propriety and methods of grounding the neutrals of the three-wire secondary system were discussed in the paper.

The whole subject has received careful attention during the past three years from electrical engineers and technical and commercial societies in the electrical field. Although differences of opinion have naturally arisen as to details, both regarding the scope of grounding and the methods to be employed, there has nevertheless been a decided and uniform expression from all electrical interests that secondary circuits, in general, should be permanently and effectively grounded. The National Electrical Code now provides for the grounding of alternating-current secondaries for e.m.fs. up to 250 volts. This maximum e.m.f. was decided upon after extensive investigation and discussion, and while many believed that the maximum e.m.f. should be 150 volts, it is interesting to note that either limits would include the lighting distribution system of almost every central-station company in the country. Considering the personal hazard, it is far more necessary to protect the lighting system by grounding than it is to protect the regular motor circuits. With many companies the same single-phase secondaries carry a mixed lamp and motor load, all of which on a grounded system would, of course, be protected. More persons are subject to electric shocks from lamp wires than from motor wires, because of the larger number of lighting installations and the larger number of people handling the lighting wires, sockets, fixtures, etc.

As Dr. Steinmetz has pointed out, it is comparatively easy to insulate from a known potential, but practically impossible in the case of unknown voltages. With alternating-current systems one must constantly guard against unknown pressures, which may possibly run as high as 60,000 volts. This is equally important in the protection of both life and property. Though a cross with a 50,000-volt system may occasion no immediate injury or burn-out, a heavy leak may occur, which sooner or later will result in disaster. In the case of lightning or a breakdown, causing a cross with a 50,000-volt system, the probability of a fatality or a fire is almost a certainty. One is, therefore, led to the conclusion that the only safe way to prevent an excessive voltage from entering buildings is to ground the service wires thoroughly outside the premises.

Considerable difference has been found to exist in practice in the detailed methods of securing a good reliable ground connection. It is one thing to get a temporary ground contact, but quite another to secure one that is absolutely dependable under all conditions of climate and weather, and one that will not be disturbed or corrode off or otherwise become inoperative. All are familiar with the usual methods of grounding lightning arresters by means of sheets or plates of metal buried in a charcoal pit, or with plain galvanized pipe driven to varying depths into the ground. The chief reason such methods of grounding are uncertain is that there are comparatively few subsoil conditions in most cities where permanent moisture can be obtained at a reasonable depth from the surface. Many localities are situated as is Minneapolis, where the soil consists of coarse sand and gravel, which absorbs moisture readily, but drains it away with equal readiness. Moreover, in modern cities the system of sewers is so ample that water seldom has an opportunity of penetrating to a depth of more than a few inches. There is, therefore, what has properly been called a surface ground connection. The surface ground contact is deceitful.

Mr. Dustin called attention to a case which occurred in Minneapolis under his notice last summer. In carrying out a series of experiments on ground connections the central-station company had driven about 20 ft. of 0.75-in. galvanized pipe into the ground beside an electric light pole. The secondary of the

transformer had been attached to this pipe. He noticed one day when passing that children were playing the exciting game of taking shocks from the iron pipe, which was supposed to be thoroughly and effectively grounded. The pole was a short distance from the catch basin to the sewer. On investigation it was found that although there had been rain during the night the ground rod or pipe was insulated from the ground. The children, however, were grounded through the damp surface of the earth and on account of the ground elsewhere in a consumer's house they were getting 110-volt shocks. This is a case where an unreliable ground would have been not entirely useless, but absolutely dangerous in the case of lightning or other high potential coming into contact with the secondaries.

A series of tests was conducted by the Minneapolis General Electric Company from May 2 to 9, 1908. These were made with 60-cycle alternating current on pipe and plate grounds in different parts of the city. The figures given in the accompanying table show the resistance in ohms between the free end of the pipe and the fire hydrant in the immediate vicinity.

The pipe used was of 1-in. galvanized iron driven into the ground. The ground plates referred to were copper, approximately 2 ft. square buried at a depth of from 7 ft. to 8 ft., with 2 in. or 3 in. of coke above and below the plate. The plates had been installed a year or more, while the pipes tested were driven a month previous to the test. The weather conditions during the previous few weeks had been such that it is believed that the ground contained as much moisture as at any time during the year, there having been considerable rain and melting snow. The soil varies from sand on top to almost pure clay.

Besides the many public recommendations of experts on this subject, Mr. Dustin said that he had ascertained the opinions from the local insurance bureau, Mr. Charles L. Pillsbury, consulting engineer; Prof. George D. Shepardson, of the University of Minnesota; the St. Paul Gas Light Company; Mr. Waldmear Michaelson, city electrician, of Omaha; Mr. Walter C. Allen, of the electrical department of the District of Columbia; Mr. William S. Boyd, electrical inspector of the electrical bureau of the National Board of Fire Underwriters, in Chicago, and Mr. James E. Cole, commissioner of wires, of Boston. Each of these not only advises strongly in favor of grounding the neutral wires of secondary circuits, but condemns the practice of attempting to ground to anything but underground systems of piping, preferably water pipes. They also unanimously agree that absolutely nothing is to be feared with such an arrangement from electrolysis. The St. Paul Gas Light Company shows its belief in this statement by grounding secondaries to its own underground gas piping. When one considers that there is absolutely no current in the ground wire from the secondaries under normal condition, he can readily appreciate that the concern of water boards in this connection is unfounded.

It is, indeed, unfortunate that those having charge of municipal and corporation water systems do not appreciate this fact because through their disapproval of such grounding many accidents have resulted. Mr. Dustin, however, is hopeful that the day is not far distant when hydraulic engineers and water boards will not only consent to such bonding of secondaries to water pipe, but will assist in requiring it. In Minneapolis the supervisor of the city water department has not only given his consent to this system, but has taken great interest and is lending his support to its furtherance.

The Minneapolis General Electric Company has arranged to ground the neutral wires of its secondaries to the casings of the street hydrants. The details have not been entirely decided upon, but it is expected that a heavy No. 4 copper wire will be run down the pole and underground to the nearest street hydrant. The ground wires will be thoroughly soldered into brass plugs screwed into the outer casings.

Mr. Dustin recommended that the wire down the pole be protected by an angle-iron stapled in place over the ground wire, and that the wire underground be protected in non-inductive conduits. He suggests fiber. It is probable that this fiber conduit would also serve for protection of the wire on the pole, and when it is used the upper end should be carefully sealed around the ground wire.

### DISCUSSION.

Mr. Albert Kemper said that the facts given by Mr. Dustin regarding the action of the water department of Minneapolis could be used to good advantage by the central stations of the State wishing to secure permission to make grounds on water pipes. It has frequently been difficult to get this permission. The members of the association which operate combined municipal water and electric light plants can also help other members of the association in this respect by grounding their system to their own water pipe and advising cities seeking for information that the practice is safe.

In answer to a question as to how frequently secondary neutrals should be grounded, Mr. Dustin said that one good ground is better than several poor ones. Mr. Thomas Pitts explained that there are two secondary networks on his system. The network in the residence district is provided with six grounds, these being from four to eight blocks apart. Mr. Dustin said that he does not consider it good practice from an operating standpoint to connect large secondary network solidly together, because if trouble occurs on the secondary all of the primary fuses will blow and it will be difficult to get the transformers re-used without a complete shut-down. Mr. Pitts said that this accident had happened in his case, and he had as a consequence put very heavy fuses on the secondary of each transformer.

Mr. James R. Cravath explained that this trouble in operating large secondary networks could be very easily obviated. To do this it is only necessary to divide the secondary network into sections with fuses between each section midway between transformers. One section will then help another, but in case of trouble on one section, the junction fuses between sections will blow and isolate that section so that the trouble will not spread to other sections. As an officer of a company operating an electric and water system and grounding to its own pipes, he would be glad to answer any inquiries from water officials as to the safety of the practice.

TESTS ON PIPES AND PLATES GROUNDS, MINNEAPOLIS.

| Date. | Location. | No. | Soil | Grounding. | Ohms. |
|---|---|---|---|---|---|
| 5-2 | 23d Ave. N. and Emerson..... | 1 | Clay | 9-in. pipe | 15.7 |
| 5-2 | 22d Ave. NE. & University Ave. | 2 | Sand | 10- " " | 570.0 |
| 5-2 | " " " " " " | 2 | " | 18- " " | 228.0 |
| 5-4 | Dupont Ave. and 46th St. S... | 3 | " | 10- " " | |
| 5-4 | " " " " " " ... | 3 | " | 20- " " | 226.0 |
| 5-4 | 28th St. and 3d Ave. S..... | 4 | " | 10- " " | 228.0 |
| 5-6 | " " " " " ..... | 4 | " | 20- " " | 30.9 |
| 5-4 | Minnehaha Ave. and Lake St.. | 5 | Clay | 10- " " | 37.4 |
| 5-4 | " " " " " .. | 5 | " | 10- " " | 32.0 |
| 5-6 | Bedford St. SE. and Hamline.. | 6 | Clay and sand | 10- " " | 114.0 |
| 5-6 | " " " " " .. | 6 | " " " | 18- " " | 17.0 |
| 5-6 | Marshall and 9th Ave. NE.... | 7 | Sand and rock | 12- " " | 38.3 |
| 5-6 | Lyndale and Groveland Ave. S. | 8 | " | Copper platez | 32.0 |
| 5-6 | " " " " " | 8 | " | 10-in. pipe | 44.8 |
| 5-6 | " " " " " | 8 | " | 20- " " | 21.4 |
| 5-6 | Summit and James Aves. S.... | 9 | Sand and clay | Copper plate | 24.4 |
| 5-6 | " " " " " .... | 9 | " " " | 11-in. pipe | 18.3 |
| 5-6 | Church and Essex Sts. SE.....10 | | Clay | 10- " " | 37.4 |
| 5-6 | " " " " " .....10 | | " | 20- " " | 18.8 |

Mr. K. A. Hildebrand said that the secondary circuit of the municipal lighting system at St. Peter is grounded to the waterworks system, which is under the same management.

Mr. R. S. Hale said that three years ago the Edison Electric Illuminating Company of Boston took up the question of grounding, but after investigation gave up the practice of trying to ground secondary circuits at each transformer because of the difficulties of getting a good ground connection. The practice of grounding at each consumer's premises on the water pipes inside the house has been adopted. The grounding was done at the company's expense in the first place, but in the case of a new installation the consumer must bear the expense, as if it were a part of the house wiring. Considerable trouble has been experienced with the water-works authorities in this connection. The plan is satisfactory, but expensive. The cost is from $5 to $15 per consumer. When the entrance to the residence is through the attic, the cost is somewhere near the high figure, but when the entrance is in the basement the cost is nearer the low figure. The company is giving some consideration to the possibility of using the ground neutral of the four-wire, 4000-volt system for grounding the secondaries of transformers.

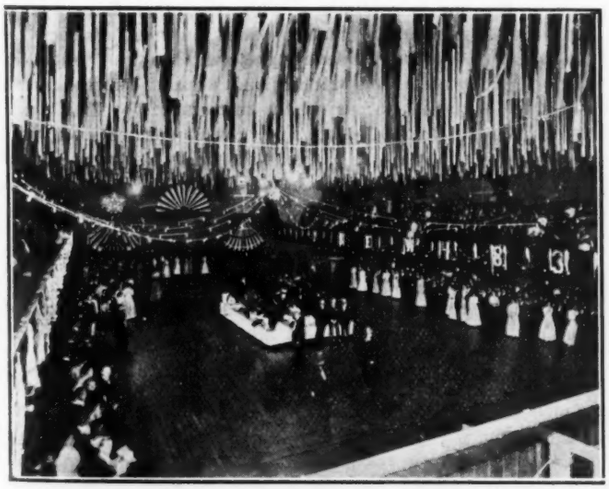
# Wiring and Illumination

## TO COMPLETE CHICAGO POST-OFFICE EXTERIOR LIGHTING.

Insufficiency of funds when the present handsome $5,000,000 Federal Building at Chicago was completed made it necessary to omit from the plan of exterior decoration the bronze candelabra statuary which were to be placed on pedestals at the four corners and at the four entrances. It is now planned to substitute dignified bronze or cast-iron standards at these points, to provide lighting for the exterior of the building, and to this end Representative Madden has conferred with Secretary of the Treasury MacVeagh for the purpose of getting an appropriation, as no money is available to complete this detail. Several different arrangements of lamps have been proposed, one of which, to cost about $15,000, provides for 24 standards on the various pedestals at the entrances and corners, each post carrying four or five 100-watt tungsten lamps contained in large frosted balls.

## SPECIAL ILLUMINATION OF TACOMA ARMORY.

One of the largest balls ever held in Tacoma, Wash., was that of the International Brotherhood of Electrical Workers, on March 17, when the attendance reached about 4000. The accompanying illustration shows the interior of the Armory, where the ball was held, and indicates the special illumination used on that occasion. The illuminating equipment used consisted of eight Grant flaming-arc lamps, each rated at 5000 cp, two spot-lamps and 1000 16-cp incandescent lamps festooned as shown in the illustration. At the north end of the hall were a 6-ft. star and a 9-ft. anchor outlined by means of incandescent lamps. Between the anchor and the star was a set piece representing the sun rising over hills. To the right of the anchor was a moving-picture machine which threw the dance numbers upon the canvas. Along the right-hand balcony was outlined by means of



Electrical Lighting of Armory at Tacoma.

incandescent lamps "I. B. E. W.," along the left-hand balcony outlined in the same manner "Welcome." At the end of the hall, not shown in the photograph, were the spot-lamps, a set piece 4 ft. x 6 ft., representing the American flag and a flasher showing the emblem of the I. B. E. W. The color scheme was green and white. The green and white crêpe paper suspended from the beams, together with tinsel cord at 4-ft. intervals, made quite a pleasing effect. The committee on decorations consisted of Mr. J. T. Riley, chairman, and Messrs. George Osborn and S. V. Peterson.

## INTERIOR AND WORKING ILLUMINATION BY LOW-VOLTAGE SERIES TUNGSTEN LAMPS.

Not the least interesting of some of the efforts acting to reduce Uncle Sam's yearly deficit in the Postoffice Department is the economy effected by the use of tungsten lamps, especially those of the low-voltage series type, with which preliminary experiments have been carried on for several months in the mailing rooms and other departments of the Chicago city post-office.

In the mailing-rooms, where letters and packages are sorted for their destinations, the general room illumination is afforded

Illumination by Tungsten Lamps in Chicago Postoffice.

by mercury-vapor lamps mounted close to the ceiling. The local or working illumination for the clerks who have to read addresses and sort the mail into boxes or cases, is provided by incandescent units. The accompanying illustration shows a typical distributing case for letters, at which three men work. It was formerly lighted by three 8-cp carbon-filament incandescent lamps mounted in adjustable brackets supported from the top of the case. The present improved illumination is by nine 5-watt, 4-cp, 12-volt tungsten lamps, connected in series across the 110-volt, direct-current mains. These series lamps are mounted at 20-in. intervals on the conduit fittings containing their wiring, and are provided with reflecting shades which project their light onto the case boxes and into the working plane at which the clerk holds the letters he is sorting.

The result of supplanting the carbon lamps by series tungstens has been marked by a substantial reduction in the power required to light a double case of this kind, a saving of more than one-half being effected in the instances of most of the distributing cases where four 8-cp carbon lamps, totaling 100 watts, have been replaced by nine 5-watt series tungstens, aggregating 45 watts.

The respective illuminations afforded by the two systems are almost beyond comparison. The tungsten lamps give a uniform distribution of their characteristic white light over the entire case and at the working plane, enabling the clerks to read addresses in comfort at any point in front of the boxes, as well as to examine the labels of the boxes themselves. The old carbon lamps were comparatively dull and produced streaky illumination which was of service only directly under the reflector. The present small tungsten lamps have a life of 2000 hours ,as against 800 hours for the carbon lamps.

An ingenious provision has been made for quickly locating the defective lamp and restoring operation to the rest of the series circuit, in case the filament of one lamp burn out thereby extinguishing all those in series on that circuit. Each socket is internally fitted with a flexible tongue which is arranged, when depressed, to short-circuit the contact pieces. As ordinarily operated, the lamps are not screwed in all the way, the tongues thus making contact only with the central buttons on

the lamps. When the circuit has been extinguished owing to some lamp having burned out, the clerk tries each lamp in succession by screwing it in tight and then back to its original position if the rest of the lamps do not light up. Obviously when he reaches the defective lamp, screwing it tight into the socket depresses the short-circuiting tongue which offers a path around the break and lights the rest of the lamps at slightly above their normal voltage. Service is thus restored until a new lamp can be obtained. Of course, this arrangement has the disadvantage that a man not familiar with the scheme might attempt to screw in all the lamps tight, thus creating a short-circuit across the line, or probably imposing a severe over-voltage on the lamps yet remaining in circuit. However, this contingency is provided against by fusing the circuits lightly, and by giving the clerks careful instructions on what to do to restore service. As the normal life of these substantial little sign tungstens is about 2000 hours, which is even usually exceeded in this building, little difficulty is experienced from burned-out lamps. The tongue-socket scheme also enables service to be restored quickly, without removing each lamp from its socket in the effort to find the defective one.

The wiring on each case ends in a pair of plugs which can be inserted into jacks on the adjacent case or connected to floor taps, enabling any change or combination of the cases to be quickly effected. Each case is fitted with a pull-chain switch, mounted at the center of the boxes.

Similar groups of series tungsten lamps are employed to light the "lumber" or newspaper cases and the bag distributing racks; in each case nine 5-watt tungstens replacing four 8-cp, 25-watt carbon lamps. At present there are 250 of these series tungsten lamps installed on the mail cases of the Chicago post office, and as the result of this preliminary experimenting, 2500, which are now being installed, will be in use for this purpose within a few weeks. When all the cases are lighted in this fashion about 40,000 lamps will be in service.

Series tungstens are also being installed to provide the slight "walking" illumination required in the extensive series of overhead "peeking galleries" used by the detectives of the post office to watch suspected postal employees at work. The Chicago post office is equipped with a complete system of conveyors for mail bags. The vertical shafts of the bucket conveyors of this system are at present lighted by 20 8-cp lamps which are kept burning at all times while the conveyors are in motion, for inspection against accident. These carbon lamps are to be replaced by 20 sign tungstens, connected in series across the 220-volt supply to the conveyor motor, and thus arranged to be lighted while the conveyor is running.

Extensive plans are now under way for replacing, lamp for lamp, much of the decorative cove and border lighting in the dome and halls of the building, using the 12-volt sign lamps in series circuits, as in the case of the mailing-room illumination.

The Chicago post-office building contains 225 motors, varying from 1/16 hp to 35 hp in capacity, driving a variety of apparatus, from the letter-cancelling machines to the passenger elevators. Although the original lighting scheme included 20,000 16-cp equivalents in incandescent lamps, this figure has been reduced by relocating and rearranging much of the illumination to the present number of 14,000 lamps. About one-third of these are 110-volt multiple tungstens, the small series lamps herein before referred to not being included in this total.

Mr. W. A. Richardson, chief electrician in charge of the Chicago post office, has initiated the work looking to economies by the use of tungsten sign lamps, and is also responsible for a number of ingenious special appliances in use about the building.

## NEW TELEPHONE PATENTS.

### NEW APPARATUS AND DEVICES.

A new design of desk stand has been invented by Mr. B. W. Sweet, of Cleveland, Ohio. The idea is to build a stand out of sheet metal parts. The hook lever is removable. The upright is divided horizontally at the height of the lever, and the switch parts are mounted upon an upright within the tubular stem. A sort of plug and jack arrangement is provided to connect the transmitter terminals with the switch terminals. The plugs go with the top section of the stem, which also carries the transmitter. The jack part is mounted on the upright, which is attached to the base. Set screws hold the plugs in the jacks. To dismantle these screws are slacked off, when the top section may be lifted off, the hook lever may be released, and the lower tube slipped off.

A transmitter muffler forms the subject of a patent granted to Mr. W. D. Plumb, of New York City. This device is a door for the transmitter mouthpiece. Its inner face is cushioned and its mounting is cushioned, so that when closed the transmitter is shielded from any sound.

The patent granted to Messrs. A. W. Lyda, of New Castle, Pa., and E. C. Robinson, of Lowellville, Ohio, describes a disinfecting device. This device lies before the transmitter mouthpiece and is automatically shifted over or away, as the case may be, by the falling or rising of the switch hook. The transmitter is exposed to the disinfecting fumes when the slide is in front of the mouthpiece.

### STEP-BY-STEP SELECTIVE SYSTEMS.

A short time ago mention was made in these columes of a step-by-step selective device, which was in the form of the ordinary polarized ringer, except that the coils with their yoke and core were suspended from the upper pole of the permanent magnet. Thus these coils could be swung from midposition, the normal, to either side, according to the direction of current in the coils. Right-hand swings advanced the selectors one step each, while left-hand swings withdrew all pawls and permitted a return to zero or normal. Mr. C. E. Nicholas, of Columbus, Ohio, and Mr. W. G. Rich, of Rochester, N. Y., have been granted a patent for a system using this selector. The circuits at each station are controlled by a mercury switch. This switch consists of a closed box with terminals projecting through the walls, supported to revolve upon its axis. An arm attached to it lies in the path of the selector part, the contact pin being spaced later at each succeeding station. As the selectors are advanced, the mercury switches are closed one after the other, thus connecting in the corresponding stations.

In the system of Mr. A. J. Farmer, of Detroit, Mich., one side of the line is continuous, while the other is in sections from station to station. Station one is normally connected to the central. A proper current impulse will ring the bell at this station. However, if this station is not desired, a direct current will cause a magnet to cut off the instruments of that station and extend the line to No. 2. The next impulse cuts off No. 2 and extends to No. 3, etc. To disconnect, a current is sent out over one side of the line and ground, which restores all stations simultaneously, thus breaking up the line.

A patent granted to Messrs. R. C. M. Hastings and T. Matheny, of Athens, Ohio, describes a system in which selection is obtained through the assistance of an operator. When a call is sent to central by the use of any station magneto, the operator responds and advances all of the selectors to short circuit all magnetos and to lock out all stations save the calling one. This station notifies the operator of the station desired, incidentally clearing its own generator. The operator then advances the selectors to the desired station number and rings. The called station is released by the process and may respond. After completion of the call, all selectors are released and return to normal position, being actuated by restoring springs.

### RECEIVERS.

One of the most remarkable features of telephony is the extreme natural sensitiveness of the telephone receiver. It is, in fact, so sensitive that there are usually detrimental effects in the form of overshadowing line noises, if too sensitive receivers are used. Nevertheless, for some purposes extremely sensitive receivers are of value, especially if they be adjustable through a considerable range, and there have recently been patented two novel, sensitive receivers. The receiver of Mr. P. M. Oliver, of Barcelona, Spain, is of the electromagnetic, in

contradistinction to the permanent magnet, type. A U-shaped yoke-piece terminated in a magnetic annulus, which surrounds the core pole. This central core carries the field winding. A second ring adjacent to the ring pole-piece supports the diaphragm. This latter carries an annular coil, which surrounds the cylindrical core end, or a cylindrical pole-piece attached to it, but without any actual contact. The permanent field may be varied by adjusting the current in the field coil. The diaphragm is actuated by the attractions and repulsions set up due to currents traversing the annular receiving coil carried by the diaphragm.

Mr. D. H. Wilson, of Chicago, has made a combined induction coil and receiver. The primary winding of the induction coil is in two parts, with a transmitter in the middle. This is overlaid by the secondary winding in several sections, which may be connected in series or parallel, as all are brought out to terminals. Each end of the coil carries a receiving cap piece and diaphragm, the core of the coil serving as the receiver pole-piece, being permanently magnetized by the currents in the primary circuit. Ear tubes lead from the receiver cap pieces.

#### AUXILIARY SWITCHBOARD CIRCUITS.

Where automatic ringing is in use a relay responsive to the rush of current following the removal of the called subscriber's telephone has usually been employed to cut off the ringing circuits. These relays are usually of the electromagnetic type and, therefore, the impedance of their coils produces a retarding or damping effect upon the ringing currents. Thermal relays have been substituted in the system patented by Mr. R. H. Manson. He uses relays of the "hot-wire" type, one member of which expanding or contracting as the magnitude of its current demands, operates a tilting lever to throw the contact springs. By using two such relays in a circuit, adjusted to opposite action, selective ringing may be controlled. One of these relays is energized by the depression of the selective key. This relay performs the usual functions of ringing keys and in addition locks itself through a locking circuit associated with the second relay. This latter operates only upon the current rush. When this rush occurs it, therefore, opens the lock and releases the ringing circuit through itself simultaneously. Both relays then cool off and return to normal condition, the cord talking circuit thus being restored. Mr. Manson has assigned his patent to the Dean Electric Company.

A new circuit for the ballast system has been patented by Mr. C. D. Enochs, of La Crosse, Wis., his patent being assigned to the Vote-Berger Company. In this circuit there are no cord relays, but the supervisory lamps are connected directly in the circuit. In this case they are connected between the two winding of each side of the coil. The lamp becomes shunted out by the subscriber's line when the receiver is off the hook, as the battery is tapped on to the circuit through high resistance coils.

#### TRANSMITTER AND TRANSMITTER ATTACHMENTS.

Of late there has been a considerable exploitation of glass mouthpieces for telephone transmitters. However, with this material special mounting methods must be resorted to, and it is such special mountings with which two patents granted to Mr. M. M. Wood, of Berwyn, Ill., are concerned. The glass mouthpieces are provided at their bases with inwardly projecting flanges. One of the attachments consists of a small metal box, which screws into the transmitter front and over which the mouthpiece slips. The bottom of the box is perforated, while tongues are raised from the sides and formed to snap over the flange of the mouthpiece. A ring of metal crimped and slit all around its inner edge is slipped on the box in front of the mouthpiece and forms a spring seat for it, while transverse holes through registering with the crimping permit a free flow of air into the cavity of the transmitter. In the other attachment no threads are required, as the side walls of the box are cut into a series of tongues, the ends of which are bent out to engage the threads in the transmitter face. A locking spider is also provided which may be used to lock the tongues in position. This spider can be turned so that each one of its arms is wedged behind one of the tongues, thereby forcing all tightly into the threads.

# LETTERS TO THE EDITOR.

## Development of Ductile Tungsten Process.

*To the Editor of Electrical World:*

SIR:—In your issue of March 24, 1910, page 728, you referred to some work done in the research laboratory of the General Electric Company on ductile tungsten in a way which reflects credit upon me personally. I wish to say that the successful work referred to is the result of the efforts of a group of operators and research men, foremost of whom are Dr. W. D. Coolidge and Dr. C. G. Fink.

*Schenectady, N. Y.* W. R. WHITNEY.

## Architects' Specifications for Electrical Work.

*To the Editor of Electrical World:*

SIR:—I was greatly interested in the article by Mr. William Sheriff Jones on "Architects' Specifications for Electrical Work" which appeared in your issue of March 31, in which the custom of many architects in devising specifications for their electrical work is deprecated. The professions of architect and engineer are each broad and exacting enough to require the undivided time and attention of those practicing either, and it is a mistake to attempt to combine them in one individual.

A practice of many architects to which, however, I particularly object is that of having a contractor prepare plans and specifications for engineering work, which are then without acknowledgment incorporated by the architect with his own. It is natural to suppose that such specifications will favor in every way possible the contractor who prepares them; and it is also natural that the contractor should expect to be favored by the architect in the letting and execution of the contract to which they pertain in view of the time and money he has spent in their preparation. Under such circumstances can the architect conscientiously serve as arbitrator in disputes arising between the owner (his client) and the contractor? To do so appears to be contrary to human nature. The architect has incurred a debt, and it is apt to be paid at the expense of his client. Let an architect apply this practice to his own affairs. Assume that he should become involved in a lawsuit. Would he consider that he was receiving a "square deal" if he discovered that his own attorney had requested the opposing counsel to prepare the architect's side of the controversy for presentation to the court?

I do not mean to intimate that all, or even a large number of architects are addicted to this pernicious practice. I have many friends among the profession for whom I have executed plans and specifications for work in various parts of the world, and for whom I entertain the highest regard; and I know of very many others who regularly engage engineers for all their engineering work. I also know that the leading contractors for heating, ventilating and electrical work maintain a corps of draftsmen and writers to prepare plans and specifications for architects, which work should be executed by competent and unbiased engineers. Let us hope that our architectural brethren will eventually see the error of their ways, and correct them in order to give their clients fair play.

*New York.* CHARLES F. SMITH.

## Central-Station Insurance.

*To the Editor of Electrical World:*

SIR:—The recent paper of Mr. W. H. Blood on "Insurance from the Engineer's Standpoint," abstracted in your issue of March 24, has presented figures and arguments which have led to a great deal of comment over the country. As in a recent editorial in your columns, if the figures given are correct, it is apparent that the average insurance rate on plants is too high.

It seems possible, however, that some of the larger losses may not be included in Mr. Blood's figures. For instance, the Trinidad, Col., plant recently sustained a loss of some $75,000 with no insurance carried. They had carried insurance for some years, but owing to increase in the rate, had canceled.

The increase in rate was brought about by very defective arrangements, although the plant construction was in most ways very good. The building was a substantial stone structure with steel trussed roof and heavy plank sheathing. The floor was principally cement in the engine-room, but with a wood floor over the cable runway and about the switchboard. The transformers were in a separate room, but the room was not drained nor cut off in standard manner from the engine-room.

A short-circuit occurred in one of the transformers and the oil escaped burning. Just about time was given for the engines to be shut down with all hands working to reduce steam. Every man was out of the station within 5 minutes, and in 15 minutes the roof was down, and except for the enclosed frame turbines, the plant was almost completely wrecked, the boiler-room and battery-room partially escaping. In this case the very things which caused the considerable increase in rate were those which caused the company to cancel, and later started the fire which caused a 50 or 60 per cent loss on the entire plant.

Insurance rates in the Central and Western States on light and power plants may be as low as 21 or 22 cents where 80 per cent of the values are insured. Where specially good construction is found, special credits are given. Plants of reinforced concrete and no exposed structural iron are in existence carrying rates as low as 15 cents on building and 23 cents on electrical contents. There are numerous plants carrying rates of about 30 cents average on building and machinery, and many more might carry rates in that proximity, but for the carelessness in maintenance of station conditions, which seems to be a prominent characteristic of electrical stations. The comparison of the condition of premises and the care for the prevention of fire hazard so far as possible between electric light and power stations and other manufacturing buildings, is certainly not at all to the credit of central-station men. The same care expended in these stations with proper disposal of waste, the removal of wood floors, wood partitions, wood additions to switchboards, avoidance of inflammable insulation in large masses and the like, as is expended on the plants themselves in their original construction, would bring about a drop in rates which would make them compare favorably with any other class.

It is a fact that in 75 per cent of electrical power stations inspected by the Underwriters, expenditures which would return in rate reductions 15 per cent or greater on investments, would bring about an average in insurance rates where careful attention to maintenance in good condition is given, of 40 or 45 cents on building and electrical equipment. In many cases fire prevention and protection seem matters of very secondary importance to central-station managements.

The original design and construction of stations is usually very superior as compared with buildings erected for other purposes and the buildings erected by light and power companies in former years, but the maintenance of good conditions and attention to fire prevention details seem to have advanced very little in the same time.

Wherever the very excellent arguments of Mr. Blood will bring about attention to such details and the matter of rate is taken up with these points in view, it is probable that rates will be found to be materially lowered and the investment in improvements in the fire hazard will be found to bring probably larger returns than the investment in any other form of improvement.

*Omaha, Neb.* Henry S. Johnston.

## Wireless Telegraph Legislation.

*To the Editor of Electrical World:*

Sir:—It seems to the writer that if our National Government would turn aside from its "regulation" propositions long enough to give consideration to what can be done by co-operation, better results would be accomplished. This is particularly applicable to the wireless telegraph bills which are, as you have pointed out repeatedly, quite too stringent and altogether premature.

An example of what I have in mind is furnished by the Bureau of Standards. The co-operation of this important bureau has been intelligent and careful, and it has made itself, in the short time of its existence, a notable force, having the good will of all of the important scientific and commercial people of the country. If the wireless telegraph regulation could be put into its charge, I do not doubt that something effective could be accomplished without such restrictions as would paralyze future research.

It must be borne in mind that some things must be done on a large scale in order to determine the commercial requirements of the art. Unfortunately, wireless on a large scale cannot be done in a corner and the only question is how far it should be restricted at all. The measles of amateur interruption will soon be over and the disease certainly does not justify imprisoning the infant in a fireproof and burglar-proof safe to die of inanition. It is significant that no Government official while employed by the Government has ever made any important invention; and no art or science which has been governmentally controlled has ever made any substantial progress. The progress in even the military art is from the outside, and is forced upon the unwilling experts in the employ of the Government.

*New York.* T. J. Johnston.

*To the Editor of Electrical World:*

Sir:—I wish to endorse the views expressed in your editorial on "The Regulation of Wireless" in your issue of April 7, 1910, in which you point out the danger of unwise legislation.

The fact that bills are introduced, referred to committees and acted upon without due notice to all the recognized wireless companies, leads one to think that some interest or interests are trying to force legislation that will promote their particular objects to the detriment of others. In cases like the present, it would appear that committees should not report on bills until all companies directly interested have had due notice and been given an oportunity to present their views.

The general public little realizes how wireless will eventually reduce their telegraph and cable tolls to a fraction of what they are to-day, or it would see that legislative proposals tending to cripple the incipient industry received short shrift.

*Providence, R. I.* Walter W. Massie,
*President Massie Wireless Telegraph Company.*

*To the Editor of Electrical World:*

Sir:—The Roberts wireless telegraph bill now before Congress provides for a board consisting of seven members as follows: One expert each from the War, Navy and Treasury Departments, three experts representing the commercial wireless telegraph and wireless telephone interests, and one scientist well versed in the art of electric wave telegraphy and telephony. The idea here is evidently to give one vote each to the government branches concerned and an equal number to the commercial interests, the balance of power being in the hands of the impartial scientist. But would this really be the result? From the many complaints filed by these departments of the Government with the House Committee on Naval Affairs—some against commercial stations, but mostly against amateurs—it is evident that the three Government representatives have a common grievance and can be relied upon to stand together. The commercial interests on the other hand are divided; of the three largest, two are opposed to all restrictive measures and one is strongly in favor of the Roberts bill. Dissension is sure to prevail on the commercial side of the commission, the solid phalanx of the Government is sure to carry its every point, and the wireless experimenter and the amateur, who have no voice whatever in the matter, are equally sure to be over-ridden and sacrificed in the cross-fire.

Apart from all other considerations, rather an unusual situation will arise with this commission. The representatives of the commercial interests, besides the salaries received from their corporations, will be paid by the Government to draft laws to rule these same corporations. It may be, too, that in appreciation of the humor of the situation and of their double

"amenability," these members will come to some agreement among themselves and eventually all come over to the side of the Government—in which case there might just as well not have been any commission.

As indicating the evil of restrictive legislation in the present state of the art, it may be pointed out that in 1906 21 governments became parties to the Berlin Wireless Telegraphy convention which, among other things, restricted their subjects to the use of certain wave-lengths less than 800 m. It has subsequently been found that waves of 1200 m and up to 3700 m are best for long-distance transmission and less subject to interference by daylight.

From the documentary and other evidence submitted to the Committee on Naval Affairs at the hearing of the Roberts bill, it is clear that nearly every complaint of "interference" comes from the Government. This means either that the Government has inferior apparatus or inferior operators—perhaps both. In this connection it is a significant fact that one company openly challenged anyone to interfere with any of its stations; the challenge was made before the committee, but was not accepted by any company represented. This same company claims that with its interference preventer, signals have been distinctly received over 3000 miles, while a powerful station close at hand was trying to interfere using a wave-length differing only 3 to 5 per cent from that of the transmitter used. In the modern arrangement it is claimed that waves ¼ per cent different in length from the one it is desired to receive can easily be entirely "cut out," and the strength of the desired signal only very slightly decreased.

It is hardly logical to suppose that the ordinary Western Union operator and train dispatcher is competent, without special instruction, to take charge of the modern high-power wireless plant. While it is true that the navy keeps its new operators at a navy yard under instruction for a couple of weeks before putting them into service on board ship, it is equally true that during that time they learn as much about wiring electric bells, searchlights, etc., and about infantry drill as they do about wireless telegraphy. The army, on the other hand, and certainly the Revenue Cutter Service of the Treasury Department, have no such provision whatever; and from these sources come most of the complaints urging restrictive legislation.

As the matter now stands, the bill has been introduced in the House of Representatives with the favorable report of the Committee on Naval Affairs, and merely awaits the form of taking a vote to start the new Wireless Board to drafting restrictive measures.

Next December, then, when the commission submits to Congress the regulations decided on, only one step—and that a mere form—will remain to deal the death-blow to future wireless development in America and to force the last link in the chain of commercial monopoly, giving over by law into the hands of a new trust the absolute and unchallenged control of the invisible ether.

*Washington, D. C.* WILLIAM C. WARD.

[Our correspondent rather summarily disposes of the part which Congress will play in giving effect to the legislative recommendations of the proposed Roberts commission, should it be authorized. Assuming that the members to be named shall enter into a conspiracy to deal a death-blow to future wireless development and shall be so venal as to formulate legislative recommendations favoring only one commercial interest, it does not follow that their recommendations will, without discussion, be enacted by Congress into law.—EDS.]

# Digest of Current Electrical Literature

**ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD**

### Generators, Motors and Transformers.

*Properties of Switch and Transformer Oils.*—W. P. DIGBY AND D. B. MELLIS.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng. The authors describe investigations of some of the physical and chemical changes in oils, due to their use in transformers and switches. The apparatus and methods employed are first referred to, after which the effects of baking temperature, disruptive tests, arc extinctions, and prolonged arcing on the properties of oils are discussed. Of the properties requisite in a mineral oil for transformers the authors urge: (1) Absence of moisture; (2) good dielectric strength; (3) a low viscosity, to facilitate the heat transfer from the core and windings to the case; (4) a flash-point expressed by a figure which is from two to three times the designed temperature limit of the transformers in degrees centigrade; (5) an absolutely neutral reaction; (6) complete absence of vegetable oils or resinoid material; and (7) freedom from metallic salts. For switchgear the authors emphasize the need of points (1), (2), (5), (6) and (7). They describe tests for determining the specific resistance and dielectric strength. For tests of dielectric strength it is advisable to choose the terminals which give the lowest possible puncturing voltage over a chosen distance, for this is the limit of what might be expected in actual practice, and give the most consistent set of results with any one oil. With one or both electrodes pointed, the second of these conditions is complied with, while with electrodes consisting of a point and disk respectively, the first condition is complied with. The authors next consider the distribution of lines of electrostatic force, or Faraday tubes, in various cases, and show that theoretically the puncturing voltage between two points would be twice that necessary to puncture half the distance between a plate and a point; and that for two spheres the curve connecting puncturing voltage and distance should be nearly a straight line in the case of spheres whose diameter is considerable, compared with the distance tested over. The experimental results are illustrated by the curves in Fig. 1. The lower full-line curve shows the relation between puncturing voltage and distance when testing between a point and disk. The upper full-line curve was deduced from the lower one by taking for each ordinate double the ordinate of the lower curve at half the

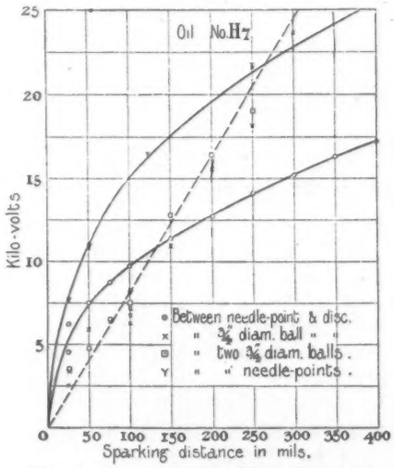



Fig. 1—Curves of Sparking Distances.

sparking distance. Thus, from the above reasoning, the upper curve should represent the relation between voltage and sparking distance when testing between two pointed electrodes. The actual points obtained by experiment between two needle-points are indicated by three-legged stars; it will be seen that

they follow very closely the theoretical curve. The points indicated by the squares were obtained by testing between two 0.75-in. balls, and it will be seen that not only are the figures obtained much more erratic than before, but that the law which they obey is totally different, and approximates to a straight-line law as indicated by the dotted line. This also is what theory leads one to expect. The points indicated by the four-legged stars were obtained by using as electrodes a 0.75-in. ball and a disk, and again, as should be expected, the figures on the whole are slightly lower than those obtained between two balls. At each puncture a certain amount of oil is decomposed, carbon is thrown down and gas escapes. This results in a darkening of the oil, but it seems from special tests of the authors that even if the oil was as black as ink its dielectric strength had not appreciably weakened. The authors then described the effect of baking and discussed physical and chemical examination of oils. As to the relation of dielectric strength to temperature the authors found that for all oils the dielectric strength increases with increasing temperature, but that consistent readings on the ascending and descending temperature curves are obtained only with oils of high specific resistance—that is, pure oils. The increase of dielectric strength with temperature throws a grave doubt on the soundness of the general practice of nearly all makers of oil-cooled transformers, who apply lower test pressures to the transformer when heated at the end of a test run than when it has been allowed to cool down. The authors finally deal with the relation of viscosity to temperature, the effect of disruptive tests on chemical and physical properties, and changes in physical and chemical properties of oil in switch tanks. To determine the effect of temperature on specific resistance, two different oils, $H_2$ and $H_3$, were tested. The insulation of a film 24 mils thick was measured between test-plates having an area of 56.8 sq. in. At 60 deg. Fahr. each oil was found to have a specific resistance of 6,000,000 megohms or over. With oil of the $H_1$ type, however, the temperature had to be raised to 214 deg. Fahr. before its specific resistance had fallen to exactly 6,000,000 megohms, which was the maximum exact value determinable with the apparatus in use. The shape of the curve indicating the effect of increasing temperature given in the left-hand diagram of Fig. 2 shows that a further increment of 54 deg. Fahr. served to reduce the specific resistance to 600,000 megohms and further indicates that initial values for specific resistance expressed as over 6,000,000 megohms may cover values many hundred times in excess of this. After heating, the oil was allowed to cool; and the left-hand curve shows that even the short application of a temperature of 280 deg. Fahr. by producing a molecular regrouping of its constituents occasioned a lower specific resistance. At 100 deg. Fahr the specific resistance was again exactly 6,000,000 megohms, and the resistance would be well over this value at 60 deg. Fahr. Oil of the $H_2$ type (right-hand diagram) on heating to 72 deg. Fahr, had then the maximum specific resistance exactly readable of 6,000,000 megohms, and on raising the temperature to 152 deg. Fahr. its value fell to 600,000 ohms. An increment of a further 100 deg. Fahr. reduced the value to 60,000 megohms. A very regular series of observations was made on the cooling curve indicating comparatively slight changes in the constitution of the oil, the value on cooling at 90 deg. Fahr. being 2,400,000 megohms, or two-thirds the value on the heating curve. The third oil tested in the same way gave a most irregular heating curve suggestive of the expulsion of moisture. It seems that the variation of specific resistance, with temperature, depends upon the grade of the oil, and it is suggested that specific resistance measurements may be used to ascertain (by comparison of a series of heating and cooling curves, with a progressive increase in temperature) the point at which the obscure point of probable molecular regrouping of the hydrocarbon constituents takes place.—Lond. *Electrician*, April 1.

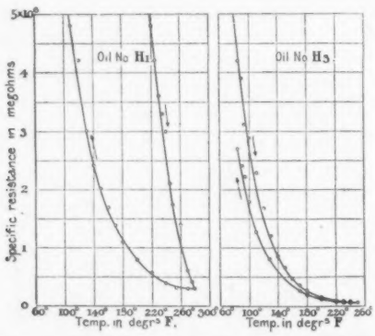



**Fig. 2—Effect of Increase of Temperature.**

*Eliminating Circulating Currents Due to Harmonics.*—A note on a recent British patent (13,041, 1909; March 24, 1910) granted to Siemens Brothers' Dynamo Works and M. Kloss. When two three-phase generators are coupled in parallel and their neutral points connected together, any difference in the amplitudes of the third harmonics in the phase e.m.f. wave forms will result in circulating currents. To prevent this, three single-phase transformers, with a ratio of 3 to 1, are connected with their secondaries in series between the neutral point of the generator to be protected and the ground bus, so that the resultant triple-frequency e.m.f. cancels that already in the circuit.—Lond. *Elec. Eng'ing*, March 31.

*Compensated Direct-Current Machines.*—A note on a recent British patent (19,210, 1909; March 24, 1910) of the British Thomson-Houston Company (General Electric Company of this country). A field core construction suitable for high-speed turbo-generators of variable-speed motors consists of a smooth bore slotted stator with the main field and compensating windings distributed and overlapping around the periphery. This distribution is obtained with a fractional winding pitch of 50 per cent, so that short end connections are used. Each slot contains a coil of each winding, and a space is left in the slots through which air is forced axially by means of a fan.—Lond. *Elec. Eng'ing*, March 31.

*Damping.*—C. M. Guilbert.—The conclusion of his theoretical paper on the damping effect of amortisseurs confirming the theory of Boucherot.—*La Lumière Elec.*, March 26.

### Lamps and Lighting.

*Arc Lamps for Street Lighting.*—With special reference to the competitive tests between different systems of street lighting in Westminster, London, the opinions of an arc-lamp manufacturer (the manager of the Jandus Electric Company) are given. He thinks that the high candle-power flame lamp is likely to play a considerable part under the altered conditions in Westminster. It is the intention of the City Council to use large lighting units in practically all the streets scheduled in the specifications, so that as 3000 cp is the unit imposed by the Council, electric flame lamps are the only competitors that need be taken seriously. In the specifications it is stated that measurements of the candle-power given out by the lamps employed will be made at angles of 20 deg. and 50 deg. below the horizontal, but it is thought that these angles are too large, and that 15 deg. below the horizontal is about the angle at which the candle-power should be measured. Unless the posts are to be very close together, a lamp giving its maximum candle-power at an angle of 50 deg. with the horizontal, will throw a bright patch on the ground not very far from the base of the posts, and there will be a correspondingly dark space between the lamps. If, however, arrangements are so made that the maximum candle-power falls along a line making an angle of 15 deg. with the horizontal the light from two lamps placed at the usual distance will commingle, and the distribution will be more uniform. The specific consumption of the Jandus lamp, which works on the regenerative principle, is given as 0.2 watt per candle-power, as against 1 watt in the older form of Jandus enclosed lamps. As to the competition between arc lighting and gas lighting the great trouble and expense of renewing the mantles in high-pressure gas lighting, which results in high maintenance costs, are emphasized. The English arc-lamp manufacturer thinks that the lighting battle of the future will be waged between the enclosed flame arc and high-pressure gas. "The magnetite lamp is scarcely likely to be very widely employed in this country (England) in spite of its cheapness,

owing to the unsteadiness with which it burns. This unsteadiness is due to the iron core which melts to form minute globules of molten iron, which in their turn vaporize in the explosively characteristic way of this metal."—Lond. *Electrician*, April 1.

*Temperature-Resistance Coefficient of Filaments of Zirconium Lamps.*—A. KOROLKOV AND A. BARTOSEVIC.—The electrical resistance of the filament was measured between 0 deg. C. and 400 deg. C. by means of a Wheatstone bridge, the temperature being observed on a mercury thermometer. For the higher ranges, 1000 deg. C. to 1800 deg. C., the resistance was arrived at from readings of an ammeter and a voltmeter, and the temperatures were estimated by a Fery pyrometer. The temperature-resistance coefficient in the range 0 deg. C. to 1800 deg. C. is given by the relation $R_t = R(1 + 0.00388\,t + 0.00000114t^2)$. The emissivity in watts per square centimeter was found to have the following values at 400 deg., 1000 deg. and 1800 deg. respectively: $4.0 \times 10^{-12}$, $1.5 \times 10^{-12}$ and $4.17 \times 10^{-12}$. The minimum at 1000 deg. C. is considered to be due to the absorbent salt placed in the bulb before exhaustion. At very high temperatures the emissivity thus approximates to that of the ideal black body ($5.3 \times 10^{-12}$). The coefficient of expansion (linear) was measured by projecting the image of the filament upon paper, and measuring the change in length. The mean value obtained is 0.0000568. In the abstract from which this is taken, it is noted that though the filament is referred to as being of zirconium in the original paper, the zirconium lamps have filaments which consist almost entirely of tungsten.—*Journ. Russk. Fisik-Chim. Obscestva*, 41, 6 p. 258, 1909; abstracted in *Science Abstracts*, B, Feb. 25.

*Tantalum Lamp.*—A note on a new tantalum lamp placed on the market in Great Britain under the name of tantalum focusing lamp, having a new arrangement of the filament by which a maximum end-on candle-power is obtained. As shown in Fig. 3, the spider on which the filament is wound is constructed

Fig. 3—Tantalum Focussing Lamp.

in a conical shape, the apex of the cone pointing downwards. The special feature of this lamp is that it distributes the light very evenly, except toward the cap of the lamp, where the light is not required. These lamps are now being supplied for e.m.fs. of from 100 volts to 130 volts in the 25-cp size in spherical bulbs measuring approximately 75 mm in diameter. They are especially suited for places where it is desired to obtain a strong and even light without the aid of special reflectors, as for stage lighting, ceiling lighting, and decorative purposes.—Lond. *Elec. Rev.*, April 1.

*Metallic-Filament Lamps.*—A continuation of the illustrated serial on recent progress in the manufacture of metallic-filament lamps. The present installment deals with methods of arranging the filament within the globe. One peculiar arrangement mentioned is that of Timar and Dreger, who construct the filament of a series of wires of relatively great length which are held in their desired position by the influence of a magnetic field. Arrangements to prevent the emission of dust from the filaments are then discussed.—*Zeit. f. Beleucht.*, March 20.

*Drawn Tungsten Filaments.*—A note stating that under the name of mazda wire lamp a drawn-tungsten-filament lamp is to be placed on the market by the British Thomson-Houston Company. The process of conditioning tungsten in such a way that it can be drawn into filaments has been worked out in the research department of the General Electric Company of this country, and it is stated that the drawn tungsten filaments are as strong as steel of the same section.—Lond. *Electrician*, April 1.

*Train Lighting.*—An illustrated description of the latest development of the train lighting system of Brown, Boveri & Company. Each car is lighted independently by means of metallic-filament lamps. The connections are shown in Fig. 4, where *D* is a direct-current shunt generator driven by an axle of the car and generating current of the same direction when

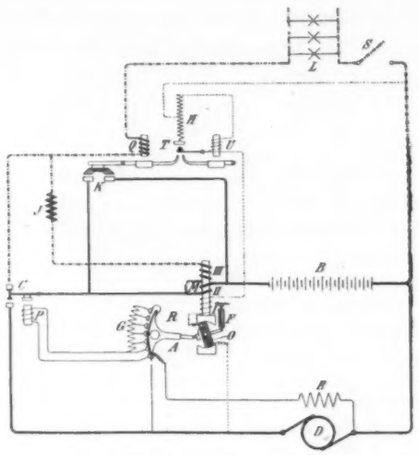


Fig. 4—Diagram of Connections.

rotating in one or the other direction. *B* is a battery, *L* the lamps of the car, and *S* the main switch, *C* an automatic switch which connects the generator to the network or disconnects it, and *R* is the automatic regulator which regulates the exciting current of the generator. This regulator consists of a magnet frame *M* and a movable coil *O*. The magnet frame *M* has three windings, I, II, III, of which I and II act in the same direction, while III acts in the opposite direction. The movable coil *O* acts on a contact arm *A*, which short-circuits or connects to the circuit the different positions of the rheostat *G* and the winding *P* of the automatic switch *C*. The position of the coil *O* when there is no current is fixed by a spring *F*. During the day the main switch *S* is open. When the train starts, the generator is excited and current passes through the circuit *O*, *I* and *U* and at a certain voltage at the terminals of the generator the movable coil *O* is moved so that the contact arm *A* releases the first contact. The armature of the contact switch *C* is now attracted and the generator is connected with the battery. Current passes now through the winding *II* to the battery and strengthens the magnetic flux of the regulator *R* so that the contact arm *A* is moved further. This happens with increasing speed of the train and in the reversing direction with decreasing speed of the train, while with increasing charge of the battery the voltage at its terminals and at the terminals of the generators is increased and the charging current is decreased. When the battery is fully charged the electromagnet *U*, which operates at a certain voltage, acts on *H* and produces a reduction of the voltage at the terminals of the generator so that an overcharge of the battery is prevented. When the speed of the train decreases, the contact arm *A* is moved gradually into the position shown in the diagram in which the winding *P* of the automatic switch *C* is without current, so that the generator is disconnected from the battery. When the speed of the train falls below a certain value, the armature of the electromagnet *U* returns to its position at rest whereby the shunt resistor at *H* is disconnected. During the night the main switch *S* is closed. The current of the lamps passes through the coil *Q* so that its armature is attracted, thereby closing the contact *T* (acting on *H* as before) and the contact *K* (disconnecting the winding *II*). When the car stops the lamp resistor *J* and winding *III* are short-circuited by the switch *C*, so that the lamps receive energy directly from the battery. When the train starts the voltage at the terminals of the generator increases and at a certain voltage the regulator *R*

causes the switch *C* to act, whereby the generator is connected to the network. The lamps receive energy from the generator through the winding *III* and the lamp resistor *J*, while at the same time there is a charging current into the battery, its size depending on the condition of charge and the intensity of the current of the lamps. To obtain constant voltage at the lamps while the number of lamps lighted is changed, the voltage at the terminals of the generator must vary with the current of the lamps; this variation is obtained by the demagnetizing action of the windings of *III*.—*Elek. Zeit.*, March 31.

### Generation, Transmission and Distribution.

*Water-Power Plant.*—G. Ferroux.—The first part of a detailed and profusely illustrated description of the water-power plant of the Brusio Company, which has the most important transmission system in Europe, supplying electrical energy to the whole of Lombardy. The power plant, which is located in the Poschiavino Valley at Campocologno, contains 12 3000-hp hydroelectric generators and four 250-hp exciters. The generating e.m.f. is 7000 volts. The article is to be continued.—*La Houille Blanche*, February.

*Steam Turbines for Propelling Vessels.*—C. A. Parsons.—A paper read before the (Brit.) Inst. of Naval Architects on the application of the steam turbine and mechanical gearing to merchant ships. Extensive tests were made on a typical slow-speed vessel which was first fitted with an ordinary triple-expansion surface-condensing engine and later with steam turbines with reduction gear. The reduction of the water consumption incident to the use of turbines is shown in diagrams.—Lond. *Electrician*, April 1.

### Traction.

*Electric Traction for Trunk Railways.*—C. Heilfron.—The conclusion of his article in which he discusses several problems of the electrification of trunk railways. He deals with the tendency to standardize the frequency between 13.3 cycles and 16.6 cycles per second, and further discusses the heating of the trains, methods of recuperating energy, and combined single-phase and direct-current systems, such as are necessary near cities where the direct-current system is used within the city and the alternating-current system outside.—*Elek. Zeit.*, March 31.

### Installations, Systems and Appliances.

*Use of the Test Wire for Telephony.*—W. Luloes.—In order to maintain good control over the network and to assist the speedy location of any fault in the insulation or short-circuit which may have arisen, it is necessary that the various distributing boxes should be connected with each other and with the central station by means of a telephone system. For this purpose telephone cables which are installed with the feeders and distributing mains are generally used. Since such a method is expensive it is recommended to use the test wires for telephony. The author describes a method which is in use at Utrecht where a three-wire direct-current system working at 2 × 220 volts is employed. The arrangement is shown in Figs. 5 and 6. The test wires *gh* and *cd* in the positive mains

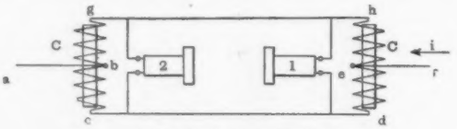



Fig. 5—Test Wire for Telephony.

are chosen as telephone wires, so that the connections of the negative main remains unaltered as far as the wire under pressure is concerned. The second negative wire is used for ringing up. *gh* and *cd* are connected together through two choking coils *CC*. The middle points of these coils *e* and *b* are connected to the bridge in the cable box and to the station voltmeter respectively. The voltmeter current from *f* splits into equal halves at *e*, half flowing along *ehg* and the other half along *edc*. At *b* they reunite, and the total current then flows through the station voltmeter to earth. The author shows that buzzing is avoided by this arrangement and further that by making the ohmic resistance of the coil small and its self-induction large perfect communication can be established between 1 and 2 without interference from the every-varying main current. According to the arrangement shown in the above illustrations the telephones are alive and have a pressure of 220 volts to earth. This is practically of little importance, but if it is desired that the telephones be not under pressure, other connections may be used which are described. Fig. 7 shows

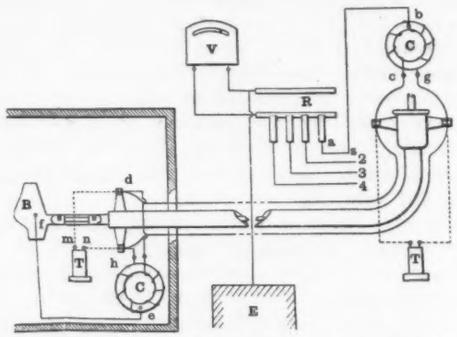



Fig. 6—Diagram of Test Wire Arrangement.

the whole arrangement for one pair of feeders, the positive of which is used for telephony and the negative for ringing up the central station from the cable box. It is hardly necessary to make the arrangement reversible—that is, to render it possible to ring up the cable box from the central station. The key *k*, when pressed, closes the circuit from the cell *c* and magnetizes *m*. The keeper n is attracted and the contact piece *s*

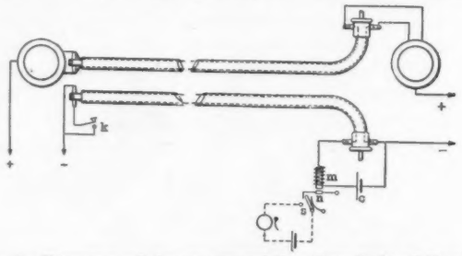



Fig. 7—Diagram of Arrangement for One Pair of Feeders.

closes the bell circuit by means of a spring. The above arrangement is suitable for a three-wire, direct-current system, but it is obvious that the same method can be applied for alternating-current systems, and tests carried out in the laboratory have shown that it is quite possible to keep the telephone sufficiently noiseless to render communication possible.—Lond. *Electrician*, April 1.

*Power-Factor Correction.*—A series of three articles. In the first article it is shown how a phase displacement between current and pressure is brought about and the detrimental effects which such a condition has on the working of the plant. Methods of remedying these difficulties are then discussed and the rôle which synchronous motors play in methods for correcting a low power-factor are discussed at some length in the second article. The third article takes up the problem of improving the induction motor or other machines which produce a low power-factor, with special reference to the exciter of Miles Walker, recently described in the Digest.—*The Engineer* (Lond.), Feb. 25, March 4 and 11.

*British Central Station.*—An illustrated description of the new generating station at Carolina Port, Dundee, which was opened recently. It is equipped with two 2000-kw, 6000-volt turbo-alternators with remotely controlled high-tension switchgear. The arrangement for condensing water supply from the river includes a special electrically driven pumping plant placed a short distance away from the station.—Lond. *Elec, Eng'ing*, March 31.

*British Central Station.*—The first part of an illustrated description of the municipal central station of Dundee, generating three-phase currents at 6600 volts and 50 cycles, for transmission to three substations, which feel a three-wire direct-

current network with 400 volts across the outers for lamps, stationary motors and the tramway system.—Lond. *Elec. Rev.*, April 1.

*Parallel Operation of Alternators.*—W. WOLF.—A review of various special arrangements which are being used by different European manufacturing companies for facilitating the operation in parallel of generators. The different methods are described with the aid of diagrams.—*Elek. und Masch.* (Vienna), March 20.

*Safety System for Mines.*—H. J. FISHER.—A paper read before the New Castle Section of the (Brit.) Inst. Elec. Eng. describing an electric safety system for use in mines, including a gate-end switch box, to reduce the risk attending the use of trailing cables and portable electrically driven machinery in mines.—Lond. *Electrician*, April 1.

*Paris Flood.*—R. CHASSERIAUD.—The conclusion of his article on the effect which the Paris flood has had on the electric central stations.—*La Lumière Elec.*, March 26.

### Wires, Wiring and Conduits.

*Wiring Rules.*—K. KOHLER.—An article comparing critically the rules for overhead wires used by the German Association of Electrical Engineers and by the Vienna Electrical Society, respectively.—*Elek. und Masch.* (Vienna), March 27.

*Copper.*—L. ODENDALL.—The first part of a statistical article on the production of copper in the United States.—*Elek. Zeit.*, March 31.

### Electrophysics and Magnetism.

*The Effect of the Metal of a Spark-Gap on the Frequency of Oscillations.*—M. WIEN.—In general, it is assumed that when a condenser is discharged through a spark-gap the frequency of the electric oscillations is given by Thomson's formula. By measurements with the rotating-mirror method a good agreement has been found between experiment and theory. On the other hand, when determining the decrement by means of resonance methods it was found that not only the decrement, but the frequency depends on the metal of the electrodes. Under otherwise equal conditions copper and silver give a longer wave-length than magnesium. For magnesium electrodes the influence of the spark-gap on the frequency is very small, and for this and other reasons magnesium is considered to be specially suitable as a metal for spark electrodes.—*Phys. Zeit.*, April 1.

*Potential Difference and Magnetism.*—E. P. ADAMS.—The author has formerly made an experimental investigation to determine whether the contact difference of potential between pairs of metals is changed by the presence of a magnetic field. His results were decisively negative. Recently Posejpal has made experiments in a different way and found a change of the contact difference of potential between iron and zinc in a magnetic field. The author discusses the difference of the arrangements of the experiments in both cases.—*Phys. Rev.*, March.

*Earth-Air Electric Currents.*—G. C. SIMPSON.—An abstract of a (Brit.) Physical Society paper which describes a method for automatically recording the electrical current which passes from the earth into the air during periods of fine weather. A large plate (17 m square) was placed in the open as near to the ground as was consistent with efficient insulation, this was then connected to an insulated vessel from which water issued through an orifice surrounded by an earth-connected cylinder. The water as it dropped from the insulated vessel carried away, by the well-known "collector" action, all the charge which the exposed plate received and the latter remained at zero potential. The charged water drops were collected in a vessel connected to a self-registering electrometer, which was earth-connected for an instant at the end of every two minutes.—Lond. *Electrician*, April 1.

*Radioactivity of Potassium.*—J. ELSTER AND H. GEITEL.—An account of an extended investigation in which the authors endeavored to find whether the radioactivity of potassium can be attributed to admixtures of other radioactive elements. The answer is in the negative; the authors consider it necessary to include potassium within the radioactive elements.—*Phys. Zeit.*, April 1.

*Fluorescence.*—E. L. NICHOLS AND E. MERRITT.—The authors determined the distribution of energy of the fluorescence spectra of fluorescein, eosin and resorufin. The curves found suggest by their form a close resemblance between black-body radiation and fluorescence, excepting that the range of wave-length in the latter case is much smaller. Attempts to find some simply modified form of Wien's equation which will represent the results have thus far been unsuccessful.—*Phys. Rev.*, March.

*Photo-Electricity.*—J. ELSTER AND H. GEITEL.—An account of an experimental investigation in which the authors found that the hydrides of the alkali metals potassium, sodium, rubidium and cæsium are colored by cathode rays. In this condition they are photo-electrically sensitive within the visible spectrum.—*Phys. Zeit.*, April 1.

### Electrochemistry and Batteries.

*Dry-Cell Tests.*—In last year's report of the (British) National Physical Laboratory it is stated that the testing of dry cells has been standardized. Four of the leading manufacturers were asked to supply on a given date 60 cells of stated dimensions for testing purposes, the cells to be made as nearly as possible at the same time and of the same materials. These were all delivered at about the specified time, and a set of four cells of each make is being subjected to each of the following discharges: 1. For five minutes per hour through a resistance of 50 ohms (the average working conditions of a telephone circuit). 2. For five minutes per hour through 1 ohm. 3. For six hours per day through 1 ohm. 4. For six hours per day through 5 ohms (National Telephone Company's test). 5. Continuously at a constant current of 200 milliamperes (Post Office test). 6. Continuously through a resistance of 10 ohms (usual manufacturer's test). 7. Continuously through 100 ohms. 8. Continuously through 500 ohms (War Office test). In addition, a number of the cells of each make are being kept unused and will be tested at the expiration of 3 and 6 or 6 and 12 months.—Lond. *Electrician*, April 1.

### Units, Measurements and Instruments.

*British Physical Laboratory.*—The conclusion of the last annual report of the (British) National Physical Laboratory. An account is given of redetermination of the mercury standards of resistance and wire standards of resistance, tests of the silver voltameter, the Ayrton-Jones current balance, and standard cells. As to the Weston standard cell for a range of temperature from 0 deg. C to 30 deg. C., it was found that the mean change in e.m.f. resulting from a change of temperature of 1 deg. C. is about $+0.00030$ volt for the cathode limb and $-0.00033$ volt for the anode limb. Because of its small total temperature-resistance coefficient the Weston cell is sometimes used in an unprotected state with respect to temperature changes, but, although rapid changes in the temperature of a cell are of little importance, it is apparent that both limbs should be at the same temperature. The large mutual inductometer has been completed. It consists of two fixed bobbins with a movable one which can turn in a plane parallel to and midway between them. Two very long ranges of mutual inductance have been obtained—namely, from 0.01 to 1000 microhenries and from 0.1 to 10,000 microhenries. The measurement of effective resistance is of great importance in telephonic and other work at high frequencies, as the energy loss in a circuit is dependent on its effective resistance and leakage. A variety of telephone loading coils and other highly inductive coils have been received for test in this respect. The methods employed have been carefully investigated in order to eliminate causes of error, which are much more difficult to avoid than those occurring in inductance measurements. In the mutual inductance bridge, large errors may be caused in the effective resistance (at telephonic frequencies) by very small self-inductances in the ratio arms. The error disappears when the inductances of the ratio arms are proportional to their resistances. When highly inductive coils have to be tested, it is best to balance the greater part of the inductance by a standard inductance coil whose effective resistance is known to be practically constant at various frequencies up to 1000 cycles per

second. The effective resistance of a highly inductive coil is much more affected by leakage than is generally supposed, and in general the effective insulation resistance falls rapidly as the frequency is raised. An account is also given of tests on telephone cables, magnetic tests, the new agreement concerning the international standard candle-power, humidity measurements in connection with flame standards of light, electric secondary standards, power measurements, ebonite investigation, research work on various insulating materials, etc.—Lond. *Electrician*, April 1.

*Photo-Electric Cell.*—Herwig.—A description of a photo-electric cell consisting of an exhausted glass tube, the bottom of which is covered with liquid potassium sodium alloy with a platinum sheet above. If the amalgam is strongly illuminated there is an electric current between the amalgam and the platinum, which is carried to the outside by means of platinum wires; the e.m.f. is said to be 0.5 volt, but since the internal resistance is 75,000 ohms, the current is very small.—*Schweitz. Elek. Zeit.*, Vol. 6, 1909, page 51; abstracted in *Elek. Zeit.*, March 31.

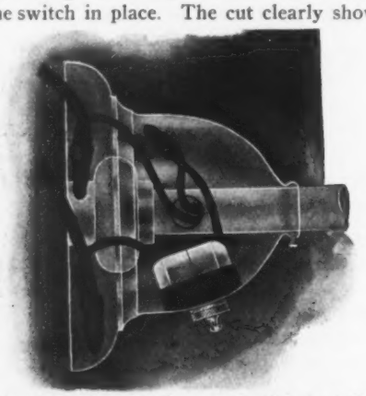
### Telegraphy, Telephony and Signals.

*Wavemeter.*—J. deBeaupre.—An illustrated description of the wavemeter of Peri, which, on account of its construction and wide range, is specially suitable for wireless telegraph equipments used by the army. It belongs to the type of wavemeters based on resonance with the circuit under test. While in general either the self-inductance or the capacity is varied, both can be changed at the same time in the Peri wavemeter—*La Lumière Elec.*, March 26.

# New Apparatus and Appliances

## CANOPY SWITCH.

The accompanying illustration is a "phantom" view of a new adaptation of the well-known and ingenious Cutler-Hammer push switch to the canopy of electric lighting fixtures. To apply this switch to any canopy or fixture, it is necessary only to drill a ⅜-in. hole in the canopy, slip the insulating nipple of the switch through the hole, and attach the ornamental nuts which hold the switch in place. The cut clearly shows the manner of installing the switch in the canopy. The switch parts are entirely enclosed in porcelain, and as an additional protection against grounds or short-circuits that portion of the switch that comes in contact with the canopy is protected by a fiber cap. This canopy switch is approved for carrying 3 amp at 125 volts, or 1 amp at 250 volts, which means that one of these little devices may be used with safety to control a six-lamp fixture on a 125-volt circuit. The arrow in the cut shows the unobtrusiveness of the projecting part of the switch, and the whole arrangement is neat and compact.



Phantom View of Canopy Switch Installed.

## SOME NEW HIGH-TENSION SPECIALTIES.

While the number of high-voltage electrical installations has increased rapidly of late years, it is perhaps questionable whether the smaller devices available for the safeguarding of electricity transmitted at high potentials have kept pace with the development of high-voltage transmission itself. The newly organized Electrical Engineers Equipment Company, of 134 Monroe Street, Chicago, has addressed itself to this problem, and the illustrations accompanying this article show some of the specialties it is manufacturing for high-voltage work. Fig. 1 gives details of a cable-end bell for 28,000-volt service, delta-connected. The details of construction shown in this cut are worthy of close inspection. Fig. 2 shows a 13,000-volt cable bell and Fig. 3 a series of split-copper tee connectors. Fig. 4 represents iron-pipe clamp insulator pins and Fig. 5 an improved busbar support.

The cable-end bells of the company mentioned are made of a special cast iron which is very soft. They are also made of malleable iron, hard brass, aluminum, copper and cast steel. Forty-eight different types are available, so that practically every condition to be met in central station or substation practice may be fitted with an appropriate device. The bells are all equipped with a patent grounding clamp ring, the particular use of which is to eliminate the soldering or wiping of joints from the cable sheath to the cable bell. This patent grounding clamp

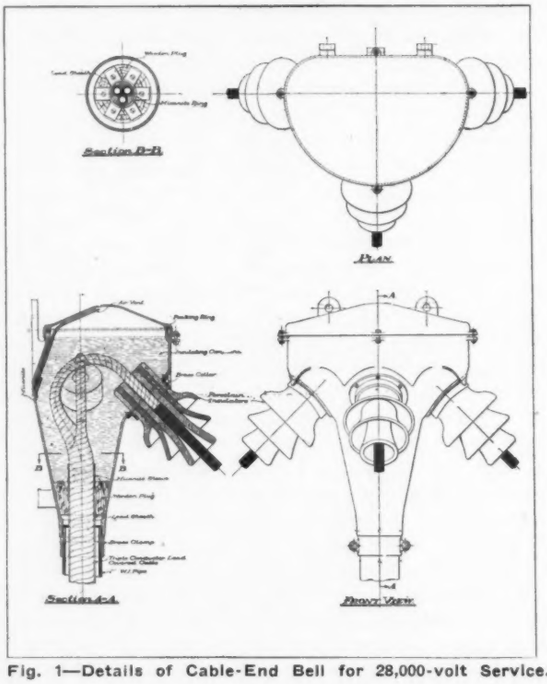



Fig. 1—Details of Cable-End Bell for 28,000-volt Service.

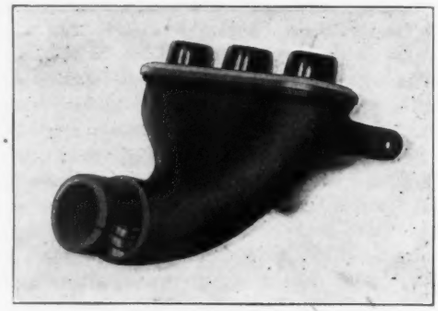


Fig. 2—13,000-volt Cable Bell.

is bored out to fit the outside diameter of the lead sheath, and is made of brass for the outside or weather cable bells. It is also tinned to make a better contact with the lead sheath.

These end bells are designed to be filled with a special insulating compound, which is furnished with them and is poured in when the cable is in position. The compound flows at about 244 deg. Fahr.

The compound is made in two grades. One of these tests to

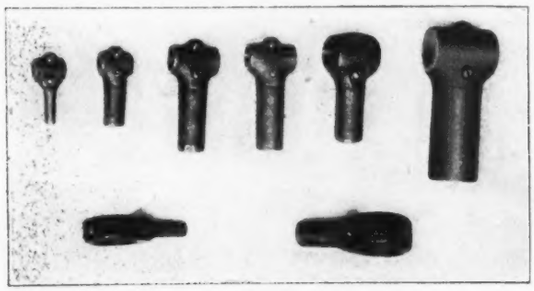


Fig. 3—Split Copper Tee Connectors.

64,000 volts and the other to 86,000 volts, both tests being with standard needle point, using a 60-cycle testing set. With a 25-cycle testing set these compounds will test much higher. Porcelain bushings are used for the leads from the cable bells, and are guaranteed to test not less than 2½ times the working voltage on the bells, delta voltage being assumed at all times. It is well known that the static discharge at the end of the cable strikes through the insulation in order to get to the ground, and the patent grounding clamp ring, clamping, as it does, the cable within a few inches of its end, prevents this static discharge and grounds it, thereby saving the insulation from static puncture.

It is contended that all cables carrying alternating-current voltages of 400 or over should be protected by cable bells. The company manufactures a special cable-end bell for mounting between oil switches on pipe framework. This is a very narrow bell. The cable bells made by the company are manufactured for voltages up to and including 28,000 volts, delta-connected. The bells provided for outside work are designed to be mounted directly on the pole, without any weather protection of any kind.

A line of malleable-iron and cast-steel insulator pins for supporting high-tension insulators is also manufactured by this company. These pins are intended for use either upon pipe framework or for mounting on a flat surface, such as busbar compartments. They may be equipped to fasten with U-bolts or they may have a solid base. The stock sizes of this

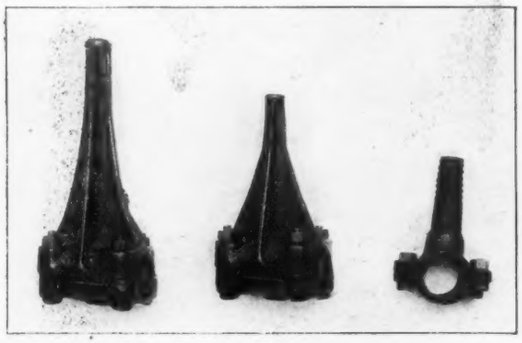


Fig. 4—Iron Pipe Clamp Insulator Pins.

type of insulator range from a height of 32 in. down to the "baby pin," which is only 5 in. high.

New designs in busbar insulation supports are also available, the insulating medium being wet-process porcelain. All metal parts connected to the busbar support are of malleable iron or brass, depending upon the amperes carried on the support. These busbar supports are made for all voltages up to and including 110,000 volts, and are made either for pipe framework or bus compartment work. The company also makes a line of wet-process porcelain line insulators. These are made for voltages up to and including 100,000 volts. Extra heavy, all-glazed, long head floor tubes are made for voltages up to and including 44,000 volts in the multiple type, and for voltages up to and including 110,000 volts in the disk and multiple types.

Among the other specialties made by this company is a line of solid cast-copper split-type tee connectors for clamping on the run to conductors ranging in size from No. 14 up to 2,000,000 circ. mils for both the conductor and the tap. Another appliance is an insulator pin with a locust wood top, which is made for mounting on flat surface or on pipe framework. The sizes carried in stock are for 1¼-in. and 2-in. pipe and up to 8 in. in height. A special pin for cementing into porcelain insulators, used largely for bus compartment work, is also made by this company.

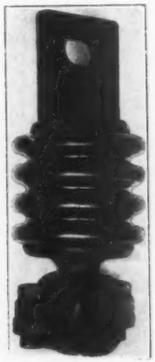
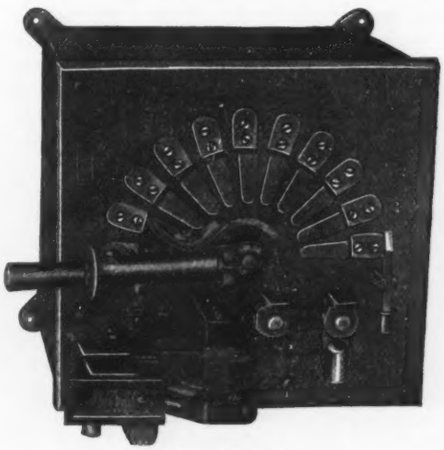


Fig. 5—Busbar Support.

## STARTING RHEOSTATS FOR LARGE MOTORS.

Starting rheostats for use with small and medium-sized motors are generally designed with a spring-actuated switch arm and a no-voltage release magnet for holding this arm in the running position. The spring tends to return the arm to the "off" position, and prevents the operator leaving part of the starting resistance in the motor circuit; it also returns the switch to the "off" position on failure of voltage, preventing full voltage being thrown on the motor without starting resistance in series, which might cause a burn-out of the armature winding. For large-size motors, because of the heavy current which must be carried by the rheostat switch and its necessarily large contact area, the friction between the movable and stationary contacts prevents the use of a spring-actuated arm, and, in addition, if the circuit is opened on the dial switch when carrying a heavy current, excessive burning of the switch contacts would result. In order to meet these conditions the General Electric Company has designed a starting rheostat for large motors, which operates as follows:

The circuit is opened and closed by means of a contactor with a strong magnetic blowout, and as the rheostat arm, when in the starting position, is still connected to the resistance, the circuit is not broken on the dial switch. There are 11 segments, so that the drop of potential between two adjacent segments is too low to cause arcing. The motor is started by slightly pressing the handle of the rheostat arm to the right when the arm is in the starting position. This energizes the contactor and throws on the line before sufficient pressure is exerted to move the rheostat arm over the contact segments. The rheostat arm is then moved in a clockwise direction until the resistance is all out of the motor circuit. If the pressure toward the right on the handle of the rheostat is relaxed, the contactor instantly opens and disconnects the motor from the line. It is then necessary to return the rheostat arm to the starting position before the contactor can be closed and the motor started. This makes this rheostat strictly fool-proof.



Starting Rheostat.

## HAND TACHOMETER

The illustration herewith represents a type of hand tachometer with direct reading scale and dead-beat action placed on the market by James G. Biddle, Philadelphia, Pa. The device is small in size, light in weight and very convenient in use. By means of a special slider the range may be widely varied without changing the connecting piece. That is, a single spindle serves for the three or four ranges that are possessed by each instrument. As compared with older types, these "Jagabi" tachometers possess many points of advantage, and are suitable for all speed tests that require commercial accuracy.

Hand Tachometer.

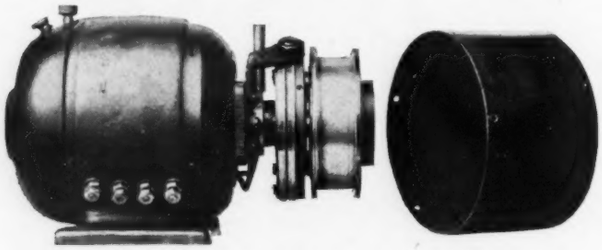
## AUTOMATIC AUTOMOBILE ELECTRIC LIGHTING SYSTEM.

The Ward Leonard Electric Company, of Bronxville, N. Y., has brought out an inexpensive and ingenious system for operating electric head lamps, tail lamps, clock and speedometer lamps, emergency or trouble lamps, road-map or reading lamps, horns, etc., on gasoline-driven automobiles. The system comprises a generator driven by belt from the engine through a magnetic clutch, two storage batteries and automatic means for keeping the electric circuits in operating condition. The electric generator is placed under the hood near the engine, this being the most desirable location; but it could be placed elsewhere if necessary. When the gear-shifting lever is moved by the chauffeur from the neutral position, the circuits to the generator field coils and the magnetic clutch are made by a switch attached to the lever. The field coils of the generator are then instantly energized from the storage battery and the magnetic clutch connects the generator to the source of power.

Fig. 1—Storage Battery Outfit.

When the speed of the engine, and consequently that of the generator, is such that the latter generates an e.m.f. slightly greater in value than that of the storage battery, an electrically operated switch, or relay, connects the generator to the battery. Should the voltage fall below that of the battery the relay automatically opens the circuit and thus prevents the battery from driving the generator as a motor. If the engine speed is too high so that the generator amperage becomes too great, another switch or relay breaks the circuit to the magnetic clutch and the generator slows down. When the speed is such that the current flow is normal, the switch, or relay, completes the circuit again and the clutch is energized and drives the generator once more. By this means the charging current is maintained between certain predetermined limits, regardless of the speed of the engine.

The arrangements are such that when the engine attains a speed such as to drive the car at the rate of 12 miles per hour or more, the generator has an e.m.f. of the proper value to charge the battery; and when the engine is stopped or is operating at a reduced speed, the batteries furnish whatever electrical energy is required. Two batteries with a throw-over switch are provided. Each battery is smaller than the ordinary sparking battery, and while one is being used for ignition work, the other may be employed for lighting. By means of the throw-over switch the connections are interchanged so that either battery may be used for ignition or lamp circuits.



. Fig. 2—Generator for Automobile Lighting.

The same battery is not employed for both purposes at once. The ignition circuit is necessarily grounded on the car frame and where the battery is used for both the ignition and lamp circuits, an accidental ground might extinguish the lights and make it impossible to start the engine. For this reason in the Ward Leonard system the ignition and lighting batteries are operated separately.

The dynamo is dustproof, and in addition a hood is provided to cover the clutch, as shown in Fig. 2. The construction is rugged and well adapted for the service for which it is intended. Tungsten lamps are used throughout for lighting and the batteries are of ample capacity to light the car completely during periods when the engine is not running. The batteries, automatic switches and throw-over switch are shown in their containing case in Fig. 1.

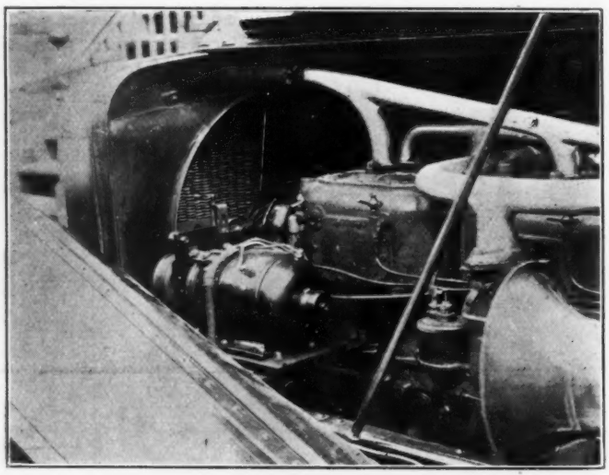


Fig. 3—View of Generator in Place.

# Industrial and Commercial News

### THE WEEK IN TRADE.

CONDITIONS of industrial and commercial trade were somewhat more cheerful during the past week than in those immediately preceding it. This does not mean that there was any particular increase in business, but that general sentiment was rather improved. Except in a few markets there was little expansion to be chronicled. The favorable weather has been very encouraging with regard to crops, and has done much to stimulate the retail trade in cities. The reverse has been the case in the agricultural district, where the farmers are too busily occupied with planting to get into market. The crop reports from all sections of the country, with the possible exception of some reports of damage to winter wheat, are extremely satisfactory. This probably is the real reason for the optimistic sentiment which prevails. There are other favorable features in the week's record, notably the amelioration of the labor situation, and also the first evidence that has occurred for several months of a sagging in the prices of agricultural products. It is believed that this may stimulate export trade, which has been extremely discouraging. Among the wholesalers and jobbers there is little fall buying, owing to the general tendency to await further information with regard to the crop prospects for the year. The increase in outdoor activities has done much to stimulate trade in hardware, implements, lumber and all kinds of building material. There has also been a very large business done during the spring in fertilizers and seed. The industrial situation is little changed, the iron and steel manufacturers being busy, and the textile manufacturers suffering from price uncertainty. Collections are somewhat better, although they vary with the different sections of the country. Failures for the week ended April 14, as reported by *Bradstreet*, were 207 as against 240 the previous week, 201 in 1909, 261 in 1908, 167 in 1907, and 167 in 1906.

### THE COPPER MARKET.

The copper metal market was somewhat more active last week, largely on account of a reduction in price. The lower prices stimulated purchasing abroad last week and there was some recovery in prices, resulting in purchases by dealers here for export to cover their European sales. In Europe there has been evidence of some increase in consumption, especially in Germany and Great Britain. The consumption by domestic melters continues heavy, estimated at between 60,000,000 and 65,000,000 lb. for the month. There is also a fair volume of business in sight for finished material, such as copper wire, sheets and brass castings. The principal feature of interest in the New York market was the action of the Calumet & Hecla Company, which dropped prices of lake early last week to dispose of its accumulated copper, but it was necessary to quote below 13 cents f. o. b. New York to secure the desired orders both from domestic and European consumers. The decline in lake copper was fully ½ cent a lb., but with larger bookings the Calumet & Hecla Company withdrew from the market on Friday. The large increase in the surplus during March seems to have taken the courage from many who had expected to see the production curtailed and at any rate held down to the consumption. There is no fault to be found with the consumption, as it is generally agreed that it is the largest in the history of the country. A prominent feature of the situation is the size of the production, which has been so far in excess of the consumption that a huge surplus has been accumulated. It is clear that until this surplus is substantially reduced the metal cannot advance in price permanently. It had been hoped that a policy of voluntary restriction would be followed so as to prevent any further additions to the supply of the metal on hand, and unless such a policy is agreed upon, it is the opinion of some of the best posted copper interests that there will be a decline in the price of the metal until curtailment is forced by the closing of some of the high cost mines. The exports of copper last week were only 3077 tons and since the first of April 6560 tons. Imports, too, have been less heavy, but proportionately greater than the exports. Since the first of April the arrivals have been 3180 tons of copper and 850 tons of matte at Atlantic ports only. Standard copper was quoted on the Metal Exchange on April 18 as per the accompanying table.

| | Bid. | Asked. | Settling price. |
|---|---|---|---|
| Spot | 12.70 | 12.85 | ..... |
| April | 12.70 | 12.85 | 12.72½ |
| May | 12.70 | 12.85 | 12.72½ |

The London market closed April 18 as follows:

| | Noon. £ | s | d | Close. £ | s | d |
|---|---|---|---|---|---|---|
| Standard copper, spot | 57 | 17 | 6 | 57 | 15 | 0 |
| Standard copper, futures | 58 | 17 | 6 | 58 | 15 | 0 |

Extreme fluctuations for this year:

| | Highest. | | | Lowest. | | |
|---|---|---|---|---|---|---|
| Standard | 13.50c | | | 12.87½c | | |
| London, spot | £62 | 0 | 0 | £57 | 15 | 0 |
| London, futures | 62 | 18 | 9 | 57 | 17 | 0 |
| London, best selected | 65 | 10 | 0 | 62 | 8 | 0 |

### INDUSTRIAL AND COMMERCIAL NOTES.

**Pennsylvania Electric Trains Under Manhattan.**—The Pennsylvania Railroad is operating regularly electric trains through the tunnels under the Hudson and East Rivers and Manhattan Island. These trains, which are made up of construction cars and are hauled by an electric locomotive, are running from New Jersey to the Sunnyside Yards in Long Island City. The extensive work on the electrification and the signaling apparatus in the tunnels is being pushed with all possible speed. Signaling bridges have been erected on the Hackensack Meadows section, and the third rail is now being laid. The tracks in the sub-river tunnels are practically completed, and the terminal station at Seventh Avenue and Thirty-third Street is also about ready for service.

**Real Estate Acquisition of Commonwealth Edison Company.**—With a view to probable future requirements, the Commonwealth Edison Company, of Chicago, has purchased from an out-of-town owner vacant property on State Street, 307 ft. south of Twelfth Street. The land acquired has a frontage of 20 ft. and extends back 144 ft. to the right-of-way of the South Side Elevated Railway Company. The Commonwealth company has its State Street substation on property adjoining the recent acquisition, and while it has no plans for the immediate utilization of the recently purchased lot, it is believed that the new property will soon be required for an addition to the substation. The price paid for the land is reported to have been $1,150 a front foot.

**New York Canal Electrical Contract.**—Contract for furnishing and installing the equipment for operating and lighting eight of the locks on the Erie, Oswego and Champlain canals has been awarded to the D'Olier Engineering Company, of Philadelphia, by the Commissioners of Public Works of New York. The amount of the contract is $178,000, and includes reinforced concrete buildings, generators, switchboards, 70 electric motors, eight water wheels with governors, head gates, etc., valve-operating machinery, traveling cranes, 10 electric capstans, lead-covered rubber insulated electric mains and various other material.

**National Electrical Credit Association.**—The National Electrical Trades Association has changed its name to "National Electrical Credit Association." The new title indicates more clearly the purpose of the organization. F. P. Vose, 1343 Marquette Building, Chicago, is general secretary and general counsel of the organization, which maintains its principal office in Chicago. Corresponding to the change in the name of the national organization, the name of the Electrical Trades Association of Chicago has been changed to "Electrical Credit Association of Chicago." Mr. Vose is likewise secretary of the Chicago association.

**Safety Insulated Wire & Cable Company.**—The construction Department of The Safety Insulated Wire & Cable Company has been awarded a contract for laying conduit at railroad crossings in Toronto, Canada, amount of contract $11,387.

**Hudson & Manhattan Railroad.**—At the annual meeting of the Hudson & Manhattan Railroad Company, C. W. King and William H. Corbin were elected directors, to succeed E. C. Converse and G. T. Rogers, who declined re-election. President McAdoo stated at the meeting that about 87 per cent of the space of the Hudson Terminal buildings is now occupied, and that he expects the buildings to be entirely filled in the near future. He said that the business of the railway line is increasing steadily, and he expects a very large increase during the coming summer. He set Oct. 1 as the probable date for the opening of the Sixth Avenue line north to the Thirty-third Street station. After that the work of constructing the line to the Grand Central Station will be immediately begun. A majority of the property owners' consents has been secured. By the veto of the bill passed by the New Jersey Legislature, authorizing the city of Newark to permit the construction of the subway under Military Park, Governor Fort has probably delayed the extension of the Hudson & Manhattan service to the center of Newark. This subway was to have been constructed by the Pennsylvania Railroad, but it would have been operated by the Hudson & Manhattan Railroad Company.

**Irrigation Order for Westinghouse Companies.**—The Westinghouse Electric & Manufacturing Company has recently entered an order for two 600-kw, 2300-volt alternating-current generators, to be installed in connection with the work of the Portales Irrigation Company, Portales, N. M. The Westinghouse Machine Company will make the gas engine to drive these and will also furnish three 500-hp bituminous-gas producers. The voltage of 2300 will be stepped up to 11,000 volts and then at the substations will be reduced to 440 volts. In connection with this irrigation project, 72 motor-driven pumps will take water from wells, 30 ft. to 50 ft. deep, and deliver it to farms in the surrounding territory. The Western Construction Company, of Wichita, Kan., has the contract for the construction work. It is expected that the cost of water per foot-acre supplied by the system will be sufficiently low to make it commercially practicable to reclaim hundreds of thousands of acres of similarly arid lands which have substrata carrying an abundance of water.

**Allis-Chalmers Turbines.**—Within the past three months the Allis-Chalmers Company has completed and delivered 48 steam turbines ranging in size from 300 kw to 2000 kw. Many of these have been installed in electric lighting stations, the list of purchasers being as follows: Virginia Electric Power & Water Company, Virginia, Minn.; Municipal Electric Light & Power Plant, Anderson, Ind.; Monmouth Public Service Company, Monmouth, Ill.; North Adams Gas Light Company, North Adams, Mass.; Citizens' Lighting Company, La Salle, Ill.; Merchants' Heat & Light Company, Indianapolis, Ind.; Public Service Corporation of New Jersey, Newark, N. J.; Wilmington City Electric Company, Wilmington, Del.; Huntington Valley Light & Power Company, Jenkintown, Pa.; Coshocton Light & Heating Company, Coshocton, Ohio; Interurban Electric Company, Herrin, Ill., and Leominster Electric Light & Power Company, Leominster, Mass.

**Western Electric Business.**—With the end of March one third of the fiscal year of the Western Electric Company was completed, and there is nothing in sight to interfere with the prediction which has been made that the business of the company will amount to over $60,000,000 for the year. The March returns show an increase of approximately 40 per cent in sales over March, 1909. The officers of the company report that this increase is well distributed between the Associated Bell companies and outside operating telephone companies, and that electric light supplies and machinery are also showing large increases. Telephone apparatus and cable sales are about 25 per cent ahead of the same period last year. At the present time the company has about 20,000 employees on its pay rolls, an increase of about 2000 since the beginning of the year.

**Development of New Tungsten Lamp.**—Robert C. Finch, consulting engineer of the Colonial Illuminating Company, New York, announces that, in collaboration with Dr. Isador Kitsee, he has succeeded in developing a new tungsten lamp after experiments extending over the past four years. Mr. Finch says that they will be able to have a demonstration of the lamp ready for testing purposes about July 1. He believes that they have succeeded in constructing a lamp that will rate at 1 watt per candle-power, and he thinks it possible that it may be even better than this. He also believes that the new filament will be as strong as a carbon filament, and that the life of the lamp will be greater than that of any tungsten lamp yet developed.

**Kerr Turbines.**—The Kerr Turbine Company, of Wellsville, N. Y., has arranged for representation in two more American and three foreign cities as follows: San Francisco and Oakland, Cal., United Iron Works; London, England, Economical Gas Appliance Construction Company, Ltd.; Mexico City, J. H. Bloomberg; Sidney, N. S. W., A. F. Partridge. With the above the Kerr Turbine Company now has active representatives in 26 cities. While the market in Europe for American turbine units of the small sizes built by this firm would hardly seem to warrant representation on the other side, yet numerous Kerr turbines have been sold in England alone, one customer there having bought seven on repeat orders.

**Lake Superior Covered by Wireless.**—Within the past week a wireless telegraph station has been established at Washington Harbor, Isle Royale, which completes a chain of wireless stations that covers the whole of Lake Superior. Isle Royale has never before been within touch of civilization, and the summer resorters and trappers who visited there have had to depend upon communication once or twice a week by boat. In addition to this new station, there are now on Lake Superior wireless stations at Port Arthur, Grand Marais, Duluth, Calumet and Marquette. This gives a complete circuit of the lake, and a boat on its waters will never be more than 100 miles from a wireless station.

**Illinois Traction Company Terminal.**—The Illinois Traction Company, which operates 530 miles of interurban railways in Illinois and is now building a bridge across the Mississippi River at Venice, Ill., in order to operate in St. Louis, has matured plans for building a terminal station in the latter city to cost $1,500,000. Several conferences have been recently held between the officials of the traction company and the officials of various steam railroads in Illinois, and it is believed that an agreement as to passenger and freight rates will soon be made which will put an end to the rate wars which in the past few years have done much to cut down earnings.

**Connecticut River Power Company.**—Although the Connecticut River Power Company has only been in full operation for about four months, the returns for March show that it earned more than its fixed charges and it is expected by the end of its first year there will be quite a satisfactory surplus. The company now has primary power contracts for 23,000,000 kw-hours, producing a gross income of $244,000, and secondary power contracts for 17,000,000 kw-hours, bringing in a revenue of $118,000. Not more than half of the available power has been contracted for, but several large negotiations are pending.

**Electrical Construction.**—Among the items printed under Construction News in our present issue are announcements of proposed new plants and considerable extensions of present plants, at Hailey, Idaho; Gary, Ind.; Trenton, N. J.; Provo, Utah; Scottsburg, Ind.; Wheatland, Wyo.; Wescosville, Pa.; Frederick, Md.; Baltimore, Md.; Vernon, Vt.; Albany, Ga.; Milford, Neb.; Linn Creek, Mo.; Helena, Ark.; Akron, Ohio; New Concord, Ohio; Colby, Kan.; Brandon, Man., Can., and Ipswich, Mass.

**May Open Steinway Tunnel.**—It is said that Mayor Gaynor is determined that the Steinway tunnel, which was completed under the East River from Forty-second Street to Long Island City some years ago, shall be put into operation. In a recent address Mayor Gaynor spoke of tentative plans which would not only put this tunnel into operation, but would extend it under Forty-second Street to Broadway.

**Brakes for Interboro.**—The Interboro Rapid Transit Company has placed an order with the Westinghouse Traction Brake Company for electric-pneumatic brake equipments for all of the cars used in the subway express trains. This brake is of a special design, electrically operated, and with an independent air tank for each car, made necessary by the fact that the subway expects in the fall to operate 10-car express trains.

**New Colorado Hydroelectric Projects.**—The Boston-Colorado Power Company has filed plans for a water-power development near Glendale, Col., where a head of 1750 ft. will be utilized. The cost, including the utilization also of the water for irrigation purposes, will be over $1,000,000. A similar combined water-power and irrigation project is reported from Fort Morgan, involving a 7000-hp electric generating plant.

**To Build 60,000 Automobiles.**—The officials of the General Motors Company announce that the plants of that concern will produce this year about 60,000 cars, worth approximately $60,000,000. This is compared with an output of 28,500 cars in 1909, which were valued at about $34,000,000. The company now owns 19 subsidiary manufacturing concerns, all of which are in active operation. In September last the capital stock of the holding company was increased from $12,500,000 to $60,000,000, $20,000,000 of the latter being 7 per cent cumulative preferred upon which regular semi-annual dividends have been paid. This increase in stock has been more than sufficient to cover the recent purchases of plants, and it is not likely that any new financing will be necessary in the near future. At the present time the company is making practically all its parts, with the exception of the rubber tires, but its factories which are making "bodies" have not been able to turn them out fast enough to keep up with the other plants.

**Colorado Power Consolidations.**—Reports come from Denver alleging that plans are now on foot for the combination of all the light, power and irrigation companies of the State of Colorado, and that the merging of the Northern Colorado Power Company and the Southern Colorado Power Company will be the first step in this combination. It is also reported that Henry L. Doherty is the moving spirit in the proposed combination. At the office of Henry L. Doherty & Company, in New York, an absolute denial was made that Mr. Doherty is in any way connected with the reported combination of power companies. The statement that Mr. Doherty had called to New York two of the best posted engineers of Colorado, for the purpose of working out the details of the plan, was also pronounced to be without foundation in fact.

**Kings County Electric Light & Power Company.**—According to the officials of the Kings County Electric Light & Power Company, the earnings of that corporation thus far in 1910 have shown substantial increases, both in gross and net, over the previous year. The rate of increase is materially more than the increase in fixed charges, due to the issue in March of $2,500,000 of 6 per cent bonds. The Kings County Company owns the entire capital stock of the Edison Electric Illuminating Company of Brooklyn, which company scored an excellent record during the year 1909.

**Chicago Subway Plans.**—It is said that the engineering portion of the Chicago subway undertaking, which has been entrusted to Bion J. Arnold, is sufficiently advanced to make it probable that construction work will be begun in the coming summer or fall. Practically all of the litigation which retarded the enterprise has been disposed of, and it remains only for the committee on local transportation to form an ordinance and the Council to enact it, determining the route and calling upon the traction companies to participate in its construction.

**St. Louis and Kansas City Electric Line.**—The officials of the St. Louis & Kansas City Electric Company announce that the engineering corps has finished locating 75 per cent of the line between the two cities. The capital stock of this company is $15,000,000, and it is planned to construct a double-track air line from St. Louis to Kansas City at the shortest distance possible, which is estimated at 250 miles. It is intended to install hourly local service and through fast express trains. Freight as well as passengers will be carried.

## *Financial.*

### The Week in Wall Street.

The decision of the Supreme Court, announced on Monday of last week, to rehear arguments in the American Tobacco and the Standard Oil cases, imparted a new aspect to the speculative position of the stock market. Bearishly inclined traders, who had stood short of the market for many weeks in anticipation from week to week of the handing down of an adverse decision in these two important anti-trust cases, grew impatient at the postponement of many months in the final rendering of these decisions, implied in the order of the Supreme Court recommitting these cases for argument, and were in haste as soon as the announcement from Washington reached the financial district to cover a large part of their commitments on the short side of the market. So precipitously was this movement started that prices rose abruptly in all of the active issues, the advance in prices in a single half-hour exceeding in importance the advances recorded during any full session in a long time. Encouraged by the ease with which the market rose in response to this short-covering movement operations on the long side of the account were resumed with more vigor and with greater confidence than had been shown in many weeks, and the market from intense dulness was enlivened into greater activity than any which had been shown for at least a month. That some reaction should take place following this burst of strength was most natural, but such recessions in prices as did occur were trifling compared with the previous advances, and the complete record for the week presented a long list of very

NEW YORK.

| | Apr. 11. | Apr. 18. | Shares sold. | | Apr. 11. | Apr. 18. | Shares sold. |
|---|---|---|---|---|---|---|---|
| All.-Ch. | 10⅜ | 11 | 500 | Int.-Met., pfd. | 57¾ | 59⅛ | 28,880 |
| All.-Ch., pfd. | 38 | 39 | 900 | Mackay Cos. | 89½* | 89½* | 300 |
| Amal. Cop. | 76 | 76⅜ | 274,776 | Mackay C., p. | 77⅛* | 77⅛* | 400 |
| Am. D. T. | 20½* | 20½* | —— | Man. Elev. | 134 | 136½ | 516 |
| Am. Loc. | 52⅛ | 52 | 300 | Met. St. Ry. | 15* | 15* | —— |
| Am. Loc.,pfd. | 114* | 113 | 6,510 | N.Y.&N.J.Tel. | 139¼* | 139¼* | —— |
| Am. Tel. & C. | 75 | 75* | 100 | Steel, com. | 85¾ | 86¼ | 1,607,500 |
| Am. T. & T. | 136½ | 138 | 9,025 | Steel, pfd. | 120⅛ | 121¾ | 14,115 |
| B. R. T. | 78½ | 81 | 109,770 | W. U. T. | 73 | 72 | 1,610 |
| Gen. Elec. | 150* | 152 | 1,700 | West'h., com. | 66½ | 67⅜ | 5,220 |
| Int.-Met.,com. | 22½ | 22⅞ | 21,530 | West'h., pfd. | 125* | 125* | —— |

PHILADELPHIA.

| | Apr. 11. | Apr. 18. | | Apr. 11. | Apr. 18. |
|---|---|---|---|---|---|
| Am. Rys. | 45 | 45 | Phila. Elec. | 15½ | 15⅝ |
| Elec. Co. of A. | 11⅞ | 11⅞ | Phila. R. T. | 21¾ | 20¼ |
| Elec. St. B'ty | 61 | 61½ | Phila. Trac. | 86½* | 86½* |
| E. S. B'ty, pfd. | 30* | 30* | Union Trac. | 49½ | 48⅞ |

CHICAGO.

| | Apr. 11. | Apr. 18. | | Apr. 11. | Apr. 18. |
|---|---|---|---|---|---|
| Chi. City Ry. | 185* | 180 | Chi. Tel. Co. | 129½ | 129 |
| Chi. Rs., Ser. 1 | 98* | 97 | Met. El., com. | 16* | 16 |
| Chi. Rs., Ser. 2 | 30 | 29 | Met. El., pfd. | 52* | 53 |
| Com. Edison | 116 | 116* | Nat'l Carbon | 112 | 112¾ |
| Chi. Subways | 3½* | 2½ | Nat'l Car., pfd. | 120* | 119 |

BOSTON.

| | Apr. 11. | Apr. 18. | | Apr. 11. | Apr. 18. |
|---|---|---|---|---|---|
| Am. T. & T. | 136¾ | 138 | Mex. Tel. | 5½ | 6 |
| Cum. Tel. | 148 | 150 | Mex. Tel., pfd. | 7 | 7 |
| Edison E., Ill. | 255* | 255 | N. E. Tel. | 134½ | 135 |
| Gen. Elec. | 151 | 151 | W. T. & T. | 16* | 16 |
| Mass E. Ry. | 19* | 19* | W. T. & T., pfd. | 87 | 90 |
| Mass. E. R., pfd. | 88* | 88* | | | |

* Last price quoted.
Shares sold for week of April 11 to April 16.

substantial price gains. The trading subsequent to the announcement, when undoubtedly short covering was the dominant factor in the market's advance, suggested that operations on the long side of the account rather than the continuance of short covering was at the bottom of the fairly well sustained strength which the market displayed on most days of the past week. During the month of March the imports reached a total of $162,955,000 and were the largest ever recorded. The exports, on the other hand, failed to increase in any like proportion, with the result that the largest trade debit balance in any month in any year since 1897 was shown by these March figures. This excess of imports in March reduced the excess of imports for the 9 months from July 1 to March 31 to the entirely inadequate sum of $168,673,000, compared with an excess of exports for the corresponding period of $348,000,000 in 1909 and $567,000,000 in 1908. It was very clear that on such a trade statement as this the only escape from a continual gold outflow lies in the placing of large amounts of obligations with investors abroad, and for some little time this movement of our securities to the other side has been on a very limited scale. There is, however, still lacking any indication that the foreign demand will reach sufficient proportions to offset our debit balances in Europe. During the week there was a slight decrease in the rates for money, and April 18 quotations were: Call, 3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close April 18.

**Long Island Railroad Report.**—The Long Island Railroad Company's report for the year 1909 shows that there were net earnings of $316,781 in place of the usual annual deficit. It is believed that the company now is in a position to earn dividends every year. The gross receipts for 1909 amounted to $10,898,371, a gain of 11 per cent. Cost of construction, equipment and real estate during the year was $2,056,931. Contracts were made for equipping 50 steel cars with electric motors, and for 100 additional steel passenger cars, 15 combined passenger and baggage cars, and 15 baggage cars, all with electric motor equipments.

**American Telephone & Telegraph Company.**—The first quarter of the year for the American Telephone & Telegraph Company shows earnings at the rate of 10.5 per cent on the $257,000,000 of capital stock. This compares with earnings of 9.1 per cent in 1909. The gross earnings of the associated Bell telephone companies for the quarter amounted to $26,039,252. The dividends received by the American company for the quarter amounted to $4,642,272, and the total receipts from all sources were $8,889,351. President Vail says in his circular to the stockholders that it will not be possible for the company to offer any new stock to the shareholders during the current year, as the cash resources available are sufficient for all current ordinary expenditures, not only for the year, but well into next year. The company now has in its treasury of its present stock issue sufficient to meet all its demands in the near future. Nathaniel Thayer has resigned from the directorate of the company, and Eugene V. R. Thayer has been elected to fill the vacancy. The new members which were added to the board of directors, increasing the number from 18 to 25, are: Thomas H. Bailey, Harry H. Brigham, George L. Green, Henry L. Higginson, George Willis Perce, Frank E. Warner and Robert Winsor.

**Kings County Electric Light & Power Company.**—According to officials of the Kings County Electric Light & Power Company, earnings of that company thus far in 1910 have shown substantial increases in both gross and net, the net rate of increase being materially more than the increase in fixed charges, due to the issue on March 1 last of $2,500,000 debenture bonds. Notwithstanding the small improvement of only 2.37 per cent in net revenue during 1909, the number of customers increased more than 23 per cent and the total connections in 50-watt equivalents rose 14½ per cent. Earnings of the property have been so favorable during the past few years as to permit the payment of dividends uninterruptedly since 1900, the initial disbursement having been made on June 1, 1900, at the rate of 6 per cent per annum, which was increased on June 1, 1903, to 8 per cent, at which rate it has since been continued. In 1909, the total amount paid out in dividends was $800,000.

**Dr. Pearson in Rock Island Company.**—Dr. F. S. Pearson has been elected a director in the Rock Island Company as a representative of the British syndicate which has been a heavy buyer of the securities of that corporation, and is said to own not less than 20 per cent of the outstanding stock. It is said that the English interests are working in harmony with the Moore-Reid party, and the outcome may be the absorption of the Lehigh Valley by the Rock Island Company. Dr. Pearson is president of the Mexican Light & Power Company, a director in the Bahia Tramway, Light & Power Company, Brazil Railway Company, Mexican Transportation Company, Mexico Tramways Company, Rio de Janeiro Tramway, Light & Power Company, Sao Paulo Tramway, Light & Power Company, and president of the Societe Anonyme du Gas de Rio de Janeiro.

**United Railways of Baltimore.**—The United Railways & Electric Company, of Baltimore, has made its report for 1909. The gross earnings were $7,209,984, an increase of $375,182 over the previous year, and the surplus, after paying fixed charges and taxes, was $1,131,414, an increase of $208,892 over the previous year. Out of this surplus there was charged to "extraordinary expenses" during the year $1,013,413, which mainly went toward the payment of floating indebtedness and for purchase and construction work on subsidiary properties. The number of fare passengers carried was 145,601,990, an increase of 7,200,996.

**Westinghouse Electric Sales.**—Reports from Pittsburgh say that the shipments of the Westinghouse Electric & Manufacturing Company for the month of March were $2,950,000 worth from the East Pittsburgh and Newark factories and about $500,000 from the three subsidiary companies, making a total of about $3,450,000, or at the rate of over $40,000,000 per annum. During March new orders were received considerably in excess of the shipments, while inquiries from the prospective buyers indicate a further increase in the demand of the combined facilities of the company.

**Lehigh Valley Transit Company.**—A meeting of the stockholders of the Lehigh Valley Transit Company, Allentown, Pa., will be held on May 19 to authorize the issue of a $10,000,000 refunding and improvement mortgage. The issue of $6,000,000 of bonds will also be authorized, which will be used to retire $2,500,000 of 4 per cent bonds, and $900,000 of 6 per cent notes which are now outstanding. The balance of the proceeds will be used for extensions and improvements.

**Massachusetts Electric Companies.**—The operating companies of the Massachusetts Electric Companies made an increase of $60,000, or about 11.6 per cent, in gross earnings during the month of March. This is the largest percentage of increase and the second largest actual increase for any month thus far in the current fiscal year. The stock of the company for some months has been quite active on the Boston market, although the advance has been merely nominal.

**Wall Street Summary Changes Name.**—The name *Wall Street Summary*, which the well-known financial paper published at 26 Beaver Street has borne for 17 years has been changed to *Financial America*. The publishers of the paper believe that the latter name is more in keeping with its broadened scope.

### DIVIDENDS.

Brooklyn City Railroad Company, quarterly, 2½ per cent, payable April 15.

Columbus (Ohio) Railway Company, preferred, quarterly, 1¾ per cent, payable May 2.

Commonwealth Edison Company, quarterly, 1½ per cent, payable May 2.

Consolidated Gas, Electric Light & Power Company of Baltimore, semi-annual, 2 per cent, payable April 27.

Cuyahoga Telephone Company, preferred, quarterly, 1½ per cent, payable April 30.

East St. Louis & Suburban Railway Company, preferred, quarterly, 1¾ per cent, payable May 2.

Electric Bond & Share Company, quarterly, preferred, 1¼ per cent, payable May 2; common, 2 per cent, payable April 15.

Grand Rapids Railway Company, preferred, quarterly, 1¼ per cent, payable May 2.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent; common, 1½ per cent, both payable May 14.

Malden (Mass.) Electric Light Company, quarterly, 2½ per cent, payable April 15.

Mexico Tramways Company, quarterly, 1½ per cent, payable May 1.

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1¾ per cent, payable June 1.

Montreal Street Railway Company, quarterly, 2½ per cent, payable May 2.

Quebec Railway Company, preferred, semi-annual, 3½ per cent, payable May 1.

Railways Company General, quarterly, 1 per cent, payable May 1.

Rio de Janeiro Tramways, Light & Power Company, quarterly, 1 per cent, payable May 1.

Tampa (Fla.) Electric Company, semi-annual, 4 per cent, payable May 16.

United Electric Securities Company, Boston, preferred, semi-annual, 3½ per cent, payable May 2.

## REPORT OF EARNINGS.

| | Gross earnings. | Expenses. | Net earnings. | Charges. | Surplus. |
|---|---|---|---|---|---|
| **American Light & Traction Company:** | | | | | |
| March, 1910 | $275,348 | $9,816 | $265,532 | ..... | ..... |
| March, 1909 | 240,343 | 8,621 | 231,722 | ..... | ..... |
| Year ended March 31, 1910 | 3,463,580 | 107,840 | 3,355,740 | ..... | ..... |
| **New York Transportation Company:** | | | | | |
| Eight months ended Feb. 28, 1910 | 511,992 | 568,683 | 13,309 | † $12,619 | * $31,755 |
| Year ended June 30, 1909 | 1,079,883 | 1,019,816 | 60,067 | 178,885 | 56,679 |
| *Deficit. †Depreciation not included. | | | | | |
| **East St. Louis & Suburban Company:** | | | | | |
| March, 1910 | 200,254 | 101,546 | 98,708 | 50,297 | 48,411 |
| March, 1909 | 158,537 | 91,982 | 66,555 | 50,526 | 16,029 |
| January 1 to March 31, 1910 | 563,681 | 294,628 | 269,053 | 149,774 | 119,279 |
| January 1 to March 31, 1909 | 460,909 | 267,873 | 193,036 | 148,821 | 44,215 |

# General News

## Construction News.

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has applied to the City Council for a franchise to construct and operate an electric railway from Ensley to the new industrial City of Corey, Ala. The City Council has granted the Birmingham Railway, Light & Power Company a franchise to construct either double or single-track railway in Birmingham. A. H. Ford is president and general manager.

RIVERSIDE, ALA.—The Riverside City Development Company is planning to install an electric light plant and water works and sewerage systems.

GLENDALE, ARIZ.—The Southwestern Sugar & Land Company has awarded a contract for a pumping plant on the Agua Fria to bring up the underground waters. The equipment will include a steam plant, generators, and pump lines, generating 400 hp to operate pumps to raise 2500 gal. per minute. The plant will cost $35,000. R. P. Davis is superintendent of the Southwestern Sugar & Land Company.

BENTON, ARK.—The Benton Electric Light Company is erecting a new power house to provide for the increase in demand for electrical service. When completed, additional machinery will be installed and a day service established.

FORT LOGAN H. ROOTS, ARK.—Bids will be received until May 10 for wiring buildings and constructing an electric lighting system at Fort Logan H. Roots. Further information will be furnished on application to the constructing quartermaster at Fort Logan H. Roots.

HELENA, ARK.—The West Helena Water Company, recently organized, is reported to be contemplating the installation of a power plant, the equipment of which will include an engine-driven electric-generating unit, boilers, and pumps for both power house and water service. E. C. and J. E. Horner are interested in the company.

HOT SPRINGS, ARK.—A movement has been started in Garland County to build a monorail railway from Hot Springs to several nearby resorts.

ADIN, CAL.—Notice of appropriation of 5000 in. of waters of Ash Creek running from Ash Valley, in Lassen County, to Big Valley, in Madoe County has been filed. There is about 600 ft. fall in about 10 miles. The water is to be diverted by a pipe line to be used for electrical power purposes, which will be utilized at the Hayden Hill mines, about six miles distant from the proposed plant. It is proposed to replace steam power with electricity in the mines.

BARSTOW, CAL.—W. W. Brison is contemplating installing an electric light and power plant in connection with his ice plant, which he proposes to remove to the east end of the town.

BERKELEY, CAL.—The Great Western Power Company has petitioned the City Council for a 35-year franchise to construct and operate an electric light and power plant in Berkeley. Under the terms of the proposed franchise the city will have the right to purchase the system at the expiration of the franchise.

FRESNO, CAL.—The Fresno Traction Company has petitioned the Board of Supervisors for a franchise to construct and operate an interurban railway on certain streets and highways in the County of Fresno, bids for which will be received until April 23. C. B. Jackson, of Fresno, Cal., is superintendent.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for three additional 500-kva, oil-filled, self-cooled transformers and three 500-kva, oil-filled, water-cooled transformers.

MADERA, CAL.—The San Joaquin Light & Power Company is contemplating the erection of a transmission line from Madera to Merced, a distance of 35 miles. A. G. Wishon, of Fresno, Cal., is general manager of the company.

SAN FRANCISCO, CAL.—The San Francisco Suburban Improvement Company has submitted a proposition to the residents of the upper Sunset District, offering to construct an electric railway into the district, providing the residents agree to subscribe the difference between the market and par value of the bonds. The cost of the road is estimated at about $80,000, and the residents are asked to furnish about $20,000. The proposed railway will be about 1½ miles long.

SANTA ANA, CAL.—Bids will be received by the Board of Supervisors until May 4 for a franchise for right of way to construct and operate transmission lines for the transmission of electricity upon certain county roads and highways, for which application has been made by the Southern California Edison Company. W. B. Williams is county clerk.

TIPTON, CAL.—John Evans and Joseph Packard are reported to be interested in the establishment of an electric light plant in Tipton.

BOULDER, COL.—Extensive filings have been made by the Boston-Colorado Power Company, recently incorporated at Boulder, for the purpose of utilizing the water from the streams at the headwaters of the South St. Vraim, Jim and Left Hand creeks, and by a series of storage reservoirs and ditches convey it to Gold Lake, from which it is to be taken by a ditch along the mountain to a point opposite Glendale, where it will have a drop of about 1750 ft to the power house. After using the water for developing power it will be carried down Left Hand Creek to a point a short distance below the junction with Jim Creek, where a storage reservoir is to be constructed and the water used for irrigation purposes on a tract west of Longmont. It is reported that work will commence on the project in the near future. The cost of the work is estimated at $1,000,000. Electricity developed at the power plant will be utilized by mines and mills in this district. John Wilbur Kay, Frank D. Patterson and Thomas H. Gibson are interested in the enterprise.

FORT MORGAN, COL.—Water rights have been filed by D. W. Johnson and C. M. Ridenour on the location of the old Ford reservoir, which will have a capacity of 2,997,354,186 cu. ft., and which will be supplemented by other smaller basins. The main reservoir is located in the bed of the Platte River, where Bijou Creek enters the main channel. The dam will be one mile in length and 55 ft. high. It is estimated that from 5000 to 7000 hp can be developed, which will be supplied to the nearby towns. The water after being used will be turned into the river channel, which will be used as a carrier to a point about half way betweeen Fort Morgan and Sterling, then diverted into canals and used for irrigating 100,000 acres of land in Morgan, Phillip, Sedgwick, Logan and Yuma counties. It is expected to have the system completed within two years.

HARTFORD, CONN.—Preparations are being made by the Universal Screw Company, of Hartford, Conn., for the construction of a new factory, which will be equipped for electrical operation.

SOUTH NORWALK, CONN.—The City Council is considering the question of making improvements and extensions to the municipal electric light plant, which will involve an expenditure of about $30,000.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until April 25, under proposal No. 443, for furnishing 101 miles of buzzer wire and 30,000 ft. Type 53 cable in reel lengths of 5000 ft. each.

WASHINGTON, D. C.—Sealed proposals will be received until May 21 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for additions to power plant and distributing systems at the United States Naval Medical School Hospital, Washington, D. C. The work includes extension of present power house, installation of new boiler, steam mains and hot-water mains between power house and new buildings, combined heating and electric cable conduit; coal crusher and conveyor, circulating pumps for heating system, blowers for boilers, etc. Plans and specifications can be obtained on application to the above bureau. R. C. Holliday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 26, to furnish at the navy yards and naval stations the following supplies: Portsmouth, N. H., Schedule 2353, 18 recording wattmeters; 29 water meters. Puget Sound, Wash., or Brooklyn, N. Y., Schedule 2359, 10,000 ft. rubber insulated lead-covered cable; 2400 lb. triple braided weatherproof wire; paper insulated lead-covered cables; 16 single-phase, air-cooled transformers; cable terminals. Schedule 2372, 3000 lb. seamless drawn tubing. Mare Island, Cal., or Brooklyn, N. Y., Schedule 2360, three motors; Schedule 2372, six Dexter valve-reseating machines. Norfolk, Va., Schedule 2365, electric fixtures, etc., at the Naval Hospital. Hingham, Mass., Schedule 2370, compressed air locomotive, accumulator, etc. Applications for proposals should designate the schedule desired by number.

ALBANY, GA.—Preparations are being made by the Albany Power & Manufacturing Company for the construction of an auxiliary steam-power plant on the Muckafoonee Creek, north of Albany. The proposed plant will cost about $50,000 and will have an output of about 1000 hp. The machinery has been purchased. J. E. Sirrine, of Greenville, S. C., is preparing plans.

DONALSONVILLE, GA.—An election has been called for May 10 to vote on the proposition to issue bonds for the construction of an electric light plant and water works system.

CALDWELL, IDAHO.—Preliminary surveys are being made for a proposed electric railway from Caldwell to Roswell, which has been under consideration for some time.

CHALLIS, IDAHO.—The citizens are considering the question of establishing a municipal electric light plant and water works system in Challis. The proposition to issue bonds for the construction of same will soon be submitted to a vote.

HAILEY, IDAHO.—Plans are being considered by the Wood River Zinc Company for the construction of a power plant and mill to operate its Nay Aug group of mines in Panther Gulch. It is proposed to construct a tramway from the mouth of the deepest tunnel on its Nay Aug mines to the mill, which will be located on the Picotte Ranch. John Thomas is superintendent.

IDAHO FALLS, IDAHO.—A special election will soon be called to vote on the proposition to issue $95,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

IDAHO FALLS, IDAHO.—Negotiations are reported to have been closed whereby an electric railway will be constructed from Idaho Falls to Hizers Hot Springs, Idaho. It is said that all rights of way have been secured and that construction work will commence July 1.

OTTAWA, ILL.—Plans are being prepared by J. F. Richardson, Jr., of Ottawa, Ill., for the construction of a factory building, 20 x 100 ft., in which an electric power plant will be installed. Motors and other tools will also be required.

ROCK ISLAND, ILL.—Sealed bids will be received at the office of the Rock Island Arsenal until May 3 for material for heating and lighting, hardware, steel, iron, etc., for the fiscal year ending June 1, 1911. For further information address Lieut.-Col. F. E. Hobbs.

WESTERN SPRINGS, ILL.—The North Shore Electric Company, of Evanston, Ill., has submitted a proposition to the Village Trustees, offering to purchase the municipal electric light plant for $10,000. The company agrees to expend $5,000 in rehabilitating the water-works system. In case the company takes over the plant, a 30-year franchise is asked, with the privilege to charge 15 cents per kw-hour, with a discount of 10 per cent for electrical service; also a 10-year contract for municipal lighting, and the village also to agree to purchase all the water required for village purposes at the rate of 9 cents per 1000 gal.

CHERUBUSCO, IND.—The Cherubusco telephone system has been purchased by Henry W. Soest and associates, of Fort Wayne, Ind., for a consideration of $30,000. The company maintains exchanges at Cherubusco, Huntertown, Green Center and Laotto. The system will be extended and improved.

CONNERSVILLE, IND.—It is reported that the Connersville Light, Heat & Power Company is preparing to call for bids for enlarging and remodeling its power plant, which include the installation of new machinery. George B. Markle is president of the company.

GARY, IND.—Preparations are being made to build a large electric power plant to supply electricity to the American Sheet and Tin Plate plant and the American Bridge Works. The building will be 550 ft. long by 100 ft. wide and will be equipped with gas engines. About 20,000 hp will be developed.

INDIANAPOLIS, IND.—Arrangements are being made by the Reedy Elevator Company for the erection of a new two-story factory, 50 x 170 ft., which will be equipped for electrical operation.

SCOTTSBURG, IND.—The Town Council has decided to install a municipal electric lighting system. Electricity for operating the system will be purchased from the Indianapolis & Louisville Traction Company at 1200 volts, direct-current at the rate of three cents per kw-hour. Series tungsten lamps will be used for street lighting. The town will erect the distributing system, lamps, etc.

SULLIVAN, IND.—The Sullivan Electric Company has applied to the City Council for an extension of its contract to furnish street lighting. The company offers to furnish street lamps at the rate of $60 each per year and if granted will install new machinery in its plant at a cost of about $2,000. The company also asks for the privilege of using meters for incandescent lighting service.

UTICA, IND.—Dix & Brothers are interested in a project to construct an electric railway from Utica to Jeffersonville, a distance of six miles. It is also proposed to build a line from Bethlehem to Owen and Charlestown.

LAKE CITY, IA.—The Central Mutual Telephone Company is making extensive improvements to its local system, including the erection of a new exchange building. The cost of the entire work is estimated at $20,000.

ATCHISON, KAN.—Arrangements have been made whereby the Atchison Railway, Light & Power Company will extend its transmission lines to Troy, Kan., to furnish electricity in that town and to farmers along the route. Work on construction of the proposed line will commence in the near future.

COLBY, KAN.—Sealed proposals will be received by C. V. Parrott, city clerk, Colby, Kan., until May 3, for the construction of an electric-light plant. Plans can be seen at the office of the city clerk, and copies obtained at the office of Burns & McDonnell, consulting engineers, Scarrill Building, Kansas City, Mo., upon a deposit of $5.

COLDWATER, KAN.—We have been informed that the J. S. Worley Company, Reliance Building, Kansas City, Mo., has been engaged to prepare plans and specifications for an electric light plant and water works system in Coldwater, Kan., to cost $30,000.

FORT SCOTT, KAN.—The Fort Scott Gas & Electric Company is reported to be considering increasing the output of its power plant and may install a steam turbine or producer gas unit.

TROY, KAN.—The Atchison Electric Light & Power Company has entered into a contract with the City of Troy, under the terms of which the company is to furnish electricity to the city for a consideration of $25 a day. The City of Troy is to erect and own the transmission line from Atchison city limits to Troy. The cost of the line is estimated at about $16,000.

PADUCAH, KY.—Extensive improvements are contemplated by the Paducah Home Telephone Company to its system in this city and in the southwestern part of the State, which will involve an expenditure of about $25,000, and include the erection of a line to Cairo, Ill., and other new lines in this part of the State.

NEW ORLEANS, LA.—The City Council has adopted the ordinance providing for the sale of a franchise for an extension of the West End Railway to Spanish Fort and Milneburg, and for a new franchise in Algiers, from the head of Morgan and Patterson streets to a point below the town on the river.

RAYVILLE, LA.—The city is considering the question of issuing $20,000 in bonds, the proceeds to be used for the construction of an electric light plant and street paving.

SHREVEPORT, LA.—The Shreveport Gas, Electric Light & Power Company is contemplating issuing $600,000 in bonds.

DAMARISCOTTA, MAINE.—The Portland Power & Development Company is extending its transmission line to Boothbay Harbor, and is also making extensive improvements in the towns of Damariscotta, Bristol, Newcastle and Nobleboro, and will furnish electricity for lamps and motors in all of the above-named towns. The company also furnishes water in Damariscotta and Newcastle and proposes to extend the service into Nobleboro and Bristol. Electricity will be supplied from the hydro-electric power plant of the company at Damariscotta Mills, where 655 hp has been developed. Water rights are owned by the company at Bristol Mills, where, it is said, a large plant will be erected this spring.

BALTIMORE, MD.—The Atlantic Fertilizer Company, it is reported, will install an electric power plant in a building to be erected at 28 Light Street, Baltimore, Md. The equipment will include turbo-generators.

BALTIMORE, MD.—It is reported that the Hospital Commission and Supervisors of City Charities have decided to construct a central plant for lighting and heating all municipal buildings at Bayview and Sydenham Hospital; a small trolley system for hauling coal will also be built.

BALTIMORE, MD.—Bids will be received by the Board of Awards of Baltimore City, at the office of J. Sewell Thomas, city recorder, City Hall, Baltimore, Md., until May 11, for furnishing and erecting electrical and mechanical equipment for the sewage disposal works at Back River, Baltimore County, Md., according to plans on file in the office of Calvin W. Hendrick, chief engineer of the Sewerage Commission. The plans call for the following equipment: Two 150-hp, hydraulic turbines, with governors, complete; two 110-kva, alternating-current generators and exciters, complete; one 50-hp, alternating-current motor; four 35-hp, alternating-current motors; one 50-hp, alternating-current motor; one two-stage centrifugal pump; four 10-inch, single-stage centrifugal pumps; one 5-kw motor-generator; one 75-hp oil engine; three 37½-kva transformers; five 25-kva transformers; one 15-kva transformer; one 5-panel switchboard in power house; one arc lamp regulator, complete; 15 alternating-current arc lamps; one traveling crane, complete; tile and metal conduits; exterior and interior wiring; lighting fixtures; cast and wrought iron pipe and fittings, etc. Specifications and plans for sanitary contract No. 51 can be obtained at the office of the Sewerage Commission, Room 904, American Building, Baltimore, Md. A charge of $10 will be made for each set of specifications and blueprints, which will be refunded upon return of same on or before May 11. Peter Leary, Jr., is chairman of the Sewerage Commission.

BERLIN, MD.—The City Council has decided to extend the electric light and water services which were put into operation last December. The proceeds of $5,000 of a bond issue recently authorized will be used for the purpose.

FREDERICK, MD.—The Frederick Railway Company is contemplating the construction of a large electric power plant. Extensions are contemplated by the company, which include equipping the railway to Thurmont, now operated as a steam road. The line will eventually be extended to Brunswick.

THURMONT, MD.—At an election held April 11 the proposition to issue bonds for municipal ownership of an electric light plant was carried.

GILBERTVILLE, MASS.—The George H. Gilbert Company has installed an electric power plant to operate its mills. The mills were formerly operated by steam power.

GREENFIELD, MASS.—A bill has been presented to the State Legislature by the Selectmen of Shelburne and Buckland, asking that the Greenfield Electric Light & Power Company be authorized to extend its system to both towns.

IPSWICH, MASS.—At a recent town meeting it was voted to appropriate $12,000 for extensions to the municipal electric light plant. It is proposed to extend the lighting system to Rowley to furnish electricity for lamps in that town.

MARBLEHEAD, MASS.—The Lynn Gas & Electric Company and the Marblehead Gas & Electric Light Company have petitioned the State Board of Gas and Electric Light Commissioners for permission to consolidate under the name of the Lynn Ga & Electric Company. Under the terms of the consolidation the Lynn company is to take over the Marblehead company, giving 25 shares of its stock for the 200 shares of the Marblehead company, both shares being of $100 par value, and assume all debts and obligations.

MARLBORO, MASS.—The Marlboro Electric Company has purchased the plant and holdings of the Marlboro-Hudson Gas Company, and in the future both plants will be operated under one management. W. J. Webber is president of the Marlboro Electric Company.

MELROSE, MASS.—The City Council is considering changing the

street arc lamps for tungsten throughout the city, with the exception of Main Street, and establishing an all-night service.

MILTON, MASS.—The Selectmen have entered into a new contract with the Edison Electric Illuminating Company, of Boston, for lighting the streets of the town for a term of five years, under which the company is to furnish 768 incandescent lamps of 30 cp at $22.31 each per year.

NORTH ADAMS, MASS.—The Light, Heat & Power Corporation is making extensive improvements to its North Adams plant and has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1500-kw, 2300-volt, 60-cycle, 3600-r.p.m., condensing turbine. The vacuum will be maintained by an Allis-Chalmers type "C" condenser with motor-driven pumps.

SHELBURNE FALLS, MASS.—Negotiations have been closed between the Greenfield Electric Light & Power Company and the Shelburne Falls Electric Light & Power Company whereby the Greenfield company will take over the plant and holdings of the Shelburne company. It is expected that the local plant will be operated for the present, but eventually electricity for operating the local system will be furnished by Gardner Falls plant of the Greenfield Electric Light & Power Company. J. W. Stevens is president of the Greenfield company.

SOMERSET, MASS.—Preparations are being made by the Fall River Electric Light Company to erect transmission lines for distributing electricity in Somerset for lamps. The street lighting system will include about 140 incandescent lamps, to cost from $20 to $25 per lamp per year.

TAUNTON, MASS.—The Reed & Barton Silver Company is planning to build an electric power plant to operate its works, using the water power of Mill River to drive the generators.

WEST STOCKBRIDGE, MASS.—At a recent town meeting the citizens voted to install electric lamps at Williamsville, and from West Stockbridge to State Line.

WORCESTER, MASS.—The City Council has granted the Worcester & Providence Street Railway Company, of Worcester, Mass., a franchise to construct an electric railway in this city. The proposed railway will extend from Worcester to Providence, via Millbury, Sutton, Manchaug and Douglas, Mass.; and Burrville, Mohegan, North Smithfield, Smithfield and North Providence, R. I., a distance of 45 miles.

BESSEMER, MICH.—Application has been made to the City Council by A. E. Appleyard and associates for a franchise to construct an electric railway from Ironwood to Bessemer. It is understood that work will commence on construction of the railway as soon as the franchise is granted.

DETROIT, MICH.—The Detroit Show Case Company is preparing plans for the construction of a new four-story factory, 60 x 130 ft., which will be equipped for electric motor drive.

FENTON, MICH.—David L. Dillon is reported to be interested in a project to construct an electric railway connecting Fenton, Ann Arbor and Flint. The proposed railway would connect with the Ann Arbor Railroad at Ann Arbor, and with the Saginaw & Flint Railway at Flint.

AURORA, MINN.—The Village Council has decided to call an election to submit the proposition as to whether the village shall ask the State for a loan of $10,000 for the purpose of constructing a municipal electric plant for the village.

HIBBING, MINN.—It is reported that W. N. Brown and others are interested in a project to build a street car line to Alice, the cost of which is estimated at about $40,000.

MANKATO, MINN.—The plant and holdings of the Mankato Gas & Electric Company are reported to have been purchased by the Consumers' Power Company. It is understood that the new owners will make extensive improvements and enlargements to the plant this year.

MINNEAPOLIS, MINN.—It is reported that all bids for ornamental lamps on the steel arch bridge were rejected.

CHARLESTON, MISS.—The town has purchased the local electric light plant, owned by the Charleston Light & Power Company, to be operated by the municipality. The price paid for the plant, exclusive of the power machinery, which is furnished by the Lamb-Fish Lumber Company, is said to be $6,000.

McCOMB, MISS.—A franchise has been granted to W. M. and J. J. White, proprietors of the Liberty White Railroad, to construct and operate an electric railway on the principal streets of the city.

CLARKSVILLE, MO.—The citizens are reported to have voted to grant a franchise to A. C. Hope, of Cartervile, Mo., to construct and operate an electric light plant in Clarksville.

KOSKONONG, MO.—The Hynson Brothers Telephone Company has sold its local telephone system, consisting of 100 telephones and about 50 miles of rural lines, to the Mustin Telephone Company, of Koskonong, for $3,000.

LEBANON, MO.—At an election held recently the citizens are reported to have voted to issue bonds to the amount of $20,000 for improvements to the municipal electric light plant. T. B. Burley is city clerk.

LINN CREEK, MO.—The Continental Power Company is contemplating the construction of a hydroelectric power plant on the Niangua River. Two estimates have been submited by engineers, one to construct a 70-ft. dam to develop 12,000 kw, and the other for a 100-ft. dam, which would develop 16,000 kw. The dam site is located about four miles from Linn Creek. The cost of the plant is estimated at $500,000. The company proposes to transmit electricity to Sedalia, Jefferson City, Booneville and other cities. R. E. Bradford, Century Building, St. Louis, Mo., is manager.

ST. LOUIS, MO.—Owing to Public Improvements' Committee not having time to investigate the franchise of the Light & Development Company of St. Louis, the measure was dropped by the City Council.

ST. LOUIS, MO.—Arrangements are being made for illuminating Grand Avenue and Olive Street, for which a guarantee fund of $1,800 has been raised. The system will include 30 arc lamps of 3000 cp, erected on ornamental poles.

ST. LOUIS, MO.—The John Ramming Machine Company, engine builders, is contemplating the construction of a new shop at the corner of Main and Spruce Streets, St. Louis, Mo. Power plant equipment will be among the requirements for the new factory.

ALBERTON, MONT.—It is reported that a new light and power plant is being installed in Alberton.

LIBBY, MONT.—J. F. Reynaud, of Sandpoint, Idaho, has applied to the Town Council for a franchise to construct and operate an electric light and water works plant in Libby.

MILES CITY, MONT.—Preparations are being made for extensive improvements to the municipal electric light plant, water works and sewer systems, for which bonds to the amount of $250,000 were recently voted.

VIRGINIA CITY, MONT.—The Virginia City Southern Electric Railway Company has awarded the contract for the construction of its proposed electric railway to Alder, to Luther H. Leber, of New York, N. Y.

ANSLEY, NEB.—The local electric light plant, owned by P. W. Taggart & Company, is reported to have been destroyed by fire. It is understood that the plant will be rebuilt.

MILFORD, NEB.—The citizens are contemplating the construction of an electric light plant and water works system, to cost $18,500. Martz Brothers, of Seward, Neb., are engineers.

OMAHA, NEB.—Judge Munger, of the United States Circuit Court, has granted the application of Lysle I. Abbott, receiver of the Independent Telephone Company, for permission to issue $400,000 in receiver's certificates, the proceeds to be used for improvements and maintenance of the plant, which will include the erection of a new exchange building in South Omaha, at a cost of $120,000.

WYNOT, NEB.—It is reported that an electric light plant will soon be established in Wynot. It is proposed to install electrical machinery in the flour mill, which is operated by the water of Bow Creek. The plant will furnish electricity for lamps and motors in Wynot. T. N. Jones is said to be interested in the project.

LACONIA, N. H.—The Laconia Electric Lighting Company is reported to have awarded the contract for construction of its new plant, to be erected at East Tilton, to the Stone & Webster Corporation, of Boston, Mass. It is said that work will commence on the plant as soon as the East Tilton Pulp Company vacate the premises. G. M. Rossman, of Keene, N. H., is manager of the Laconia Electric Lighting Company.

ATLANTIC CITY, N. J.—Sealed bids will be received by the Board of Water Commissioners of Atlantic City, N. J., until May 3, for furnishing and installing one 150-kva, alternating-current generator, with exciter, switchboard and transformers, at the Absecon pumping station, in accordance with specifications on file at the office of the Water Department, City Hall, Atlantic City. Specifications will be mailed on application to the Water Department. L. Van Gilder is engineer and superintendent.

IRVINGTON, N. J.—The Town Council has entered into a new contract with the Public Service Corporation of New Jersey for a period of five years. Under the terms of the contract the company is to furnish 30-cp incandescent lamps at the rate of $15 per lamp per year, which is a reduction of $2 per lamp per year on the old contract, effecting a saving of $1,200 a year to the town.

NEWARK, N. J.—Orders have recently been placed by the J. H. Ladew Company with the Allis-Chalmers Company, of Milwaukee, Wis., for two 300-kw, 240-volt, three-phase, 60-cycle, 3600-r.p.m., condensing steam-turbo alternators, in connection with which Allis-Chalmers type "C" condensers will be used. Excitation will be supplied by a 7½-kw, engine-driven exciter, or a 15-kw, motor-driven exciter. A six-panel switchboard will carry the controlling instruments, and 27 induction motors, varying in size from 5 to 35 hp, will drive the machinery in the plant.

PASSAIC, N. J.—The Passaic Cotton Mills have recently awarded a contract for a 500-hp. cross-compound, non-condensing engine to increase the output of its power plant. Additional electrical equipment will also be installed.

RED BANK, N. J.—The Shore Electric Company has accepted the proposition of the Borough Commissioners to erect arches in place of arc lamps. On each arc 15 tungsten lamps will be placed. The arches burning all night will cost $100 per year and those burning until midnight $65 each per year. The term of the contract is for five years. Thirteen arches will be erected.

TRENTON, N. J.—Preparations are being made by the Trenton Water Power Company to erect a plant in this city and supply power to manufacturing plants. It is also stated that the company proposes to furnish water, steam or electrical power, besides water power for mills along the stream.

ARTESIA, N. M.—The application of William Benson, of Artesia, N. M., for 90 second cu. ft. of water on the Penasco River has been approved by Vernon L. Sullivan, territorial engineer. This project includes the construction of five power stations, which will develop about 10,980 hp, at a cost of about $150,000.

ROSWELL, N. M.—Vernon L. Sullivan, territorial engineer, has approved the application of W. P. Turner, W. R. Kinney and W. R. Allison, of Roswell, N. M., for 100 second cu. ft. of water of the Penasco River. It is proposed to develop about 1000 hp at a cost of about $25,000.

ALBANY, N.Y.—The contract for furnishing and installing electrical equipment for lighting and operating locks on the Erie, Champlain and Oswego canals, at Baldwinsville, Smith's Basin, Comstock, White Hall, Phœnix and Oswego, has been awarded by F. C. Stevens, superintendent of Public Works, to the D'Olier Engineering Company, of Philadelphia, Pa., for $178,197.

BOLIVAR, N. Y.—The Southwestern New York Traction Company is planning to begin work on construction of its electric railway between Bolivar, Scio, Allentown and Wellsville, 15 miles in length. The power station will be located in Allentown. The company will furnish electricity for lamps along the route. Charles M. Van Curren, of Bolivar, is president.

BUFFALO, N. Y.—Bids will be received at the office of Department Public Works, Room 1, City and County Hall, Buffalo, N. Y., until April 26, for doing sundry electrical work and furnishing and installing lighting fixtures required in the new 16-room school building, located on Front Avenue, near Hudson Street. Francis G. Ward is commissioner of Public Works.

BUFFALO, N. Y.—The Washingburn-Crosby Company has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for additional equipment for its Buffalo mill, practically duplicating the installation made about a year ago, which was furnished by the Allis-Chalmers Company. The contract includes flour milling machines driven by two 500-hp and one 300-hp, 440-volt, three-phase, 25-cycle, 300-r.p.m. induction motors.

FULTON, N. Y.—The Niagara-Ontario Power Company has applied to the Common Council for a franchise to distribute electricity over and under public streets in Fulton for lamps, heat and motors.

HARTWICK, N. Y.—The Hartwick Power Company has applied to the Public Service Commission, Second District, for permission to issue $300,000 in capital stock, and to execute a mortgage for $500,000; also for authority to acquire the steam power plant of the Otsego & Herkimer Railroad Company in Hartwick, and the hydroelectric development power plant of the Susquehanna River Power Company, located at Colliers, and a transmission line connected with the steam plant at Hartwick, and for approval of a contract between the Hartwick Power Company and the Otsego & Herkimer Railroad Company. The Hartwick Power Company proposes to take over the power plant of the Otsego & Herkimer Railroad Company and consolidate it with the Susquehanna River Power Company. The Hartwick company has franchises to furnish electricity for light, heat and motors in Oneonta, Cooperstown, Richfield Springs, West Oneonta, Laurens, Hartwick, Fly Creek, Schuyler Lake and Jordonville.

HUDSON, N. Y.—The Albany Southern Railroad Company is contemplating the purchase of a 400-kw rotary converter and a 350-kva, one-phase, air-blast transformer.

NORTH TONAWANDA, N. Y.—The Dodge & Bliss Company is reported to be equipping its plant for electric motor drive. It is understood that considerable equipment will be required for the mill during the coming year.

OSWEGO, N. Y.—The Public Service Commission, Second District, has authorized the People's Gas & Electric Company, of Oswego, to acquire all the property and holdings of the Citizen's Light Company, of Oswego, and operate the same. The People's Gas & Electric Company is authorized to issue $150,000 additional capital stock at par, the proceeds to be used as follows: To acquire the capital stock, together with all franchises, property, etc., of the Citizen's Lighting Company, $76,000, and the proceeds of $74,000 to be used for paying outstanding obligations, which have been incurred in construction, extension and improvement of the property of the company.

RIVERHEAD, N. Y.—The Riverhead Electric Light Company is contemplating extending its transmission lines to the South Side of the island, a distance of nine miles, to furnish electricity at Westhampton Beach.

ROCHESTER, N. Y.—Plans are being prepared by John Kelly for the construction of a six-story factory building, which will be equipped with electric-motor driven machinery.

ROCKVILLE CENTER, N. Y.—The contract for the installation of a 100-kw, 220-volt, two-phase, 60-cycle alternator and exciter has been awarded by the Village Trustees to William A. Sheehan, for $1,804.

WEST POINT, N. Y.—Bids will be received until May 3 at the office of the quartermaster, West Point, N. Y., for furnishing one continuous electric blue printing machine, as per specifications on file in the above named office. Further information furnished on application.

SPENCER, N. C.—At an election held April 12 the citizens voted in favor of the proposition to issue $25,000 in bonds for the construction of an electric light plant and water works system. Steps are being taken to install both systems at an early date.

CARRINGTON, N. D.—A company has been formed to operate a power plant to be located west of Carrington, at some point near a lignite coal supply on the Missouri River. The company proposes to furnish electricity to towns along the Turtle Lake branch of the Northern Pacific Railroad. At Carrington the electric service will be extended north to Leeds and along the Soo. F. E. Stanley is engineer.

TOWNER, N. D.—We are informed that it is not proposed to establish an electric light plant in Towner, N. D., as reported in these columns in the issue of April 7. F. B. Haines is city auditor.

AKRON, OHIO.—Plans are being prepared by the Osborn Engineering Company, of Cleveland, Ohio, for the construction of a large plant for the Alkali Rubber Company, of Akron, Ohio. A separate power plant will be installed. It is understood that the Alkali Rubber Company is in the market for power plant equipment and other machinery.

ALLIANCE, OHIO.—At an election held recently the proposition to issue $75,000 in bonds, the proceeds to be used to purchase the electric light plant and enlarge the water-works system, is reported to have been carried.

BELLEFONTAINE, OHIO.—It is reported that H. F. Houghton, general superintendent, and Earl B. Coston, division superintendent of the Big Four Railroad, are interested in a project to construct an electric railway from Bellefontaine to Sidney, a distance of 22 miles, there to connect with the Western Ohio Railroad. The Big Four Railroad has secured control of Silver Lake, a Logan County resort, and the railway will touch there. The railway will also be extended from Bellefontaine via West Mansfield and Marysville into Columbus. The company is reported to have purchased the right-of-way between this city and Sidney from the promoters of the Bellefontaine & Sidney Electric Railway.

CINCINNATI, OHIO.—Contracts have been awarded by the Board of Directors of the University of Cincinnati for the construction of the new engineering building for the University, to cost $255,000. The appropriation will permit an expenditure of $45,000 for equipment.

CINCINNATI, OHIO.—The Cincinnati, Portsmouth, Pomeroy & Pittsburg Traction Company is making surveys of its proposed electric railway from Cincinnati to Pittsburg, a distance of 466 miles. Contracts for construction of the proposed railway, it is understood, will be awarded during the summer. A. E. Cox, of Huntington, W. Va., is president.

COLUMBUS, OHIO.—Rights of way are being secured by the Columbus, Urbana & Western Traction Company for an extension of its railway from Fishinger's Bridge to Dublin, a distance of about five miles.

DAYTON, OHIO.—Plans are being considered by the Stoddard-Dayton Company for enlarging its manufacturing plant in Dayton, next Fall, which will be equipped for electrical operation.

DEFIANCE, OHIO.—The City Council is reported to have granted a franchise to T. T. Ausberry, H. D. Bokop and M. W. Steinberger, representing the Valley Power Company, to construct and operate an electric plant in Defiance, plans for which are being prepared.

ELYRIA, OHIO.—It is reported that Harry Crisp, of Elyria, Ohio, will be in the market for an engine, generator, a boiler of about 125 hp and auxiliary apparatus for an electric power plant.

NEW CONCORD, OHIO.—S. S. Wyer, Harrison Building, Columbus, Ohio, has been engaged by the Village of New Concord, Ohio, to prepare plans and specifications and take charge of the installation of the proposed new municipal electric light plant. Bids for construction of the plant will be received until May 3 by W. G. McKinney, village clerk, New Concord, Ohio, from whom specifications can be obtained. The equipment of the plant will include one 40-kw, single-phase, 2200-volt, 60-cycle alternator with direct-current exciter, switchboard with apparatus and a 50-light, constant-current regulating transformer; one 60-hp, producer-gas engine; 60-hp hard coal gas producer; 50 series tungsten street lamps, with radial wave reflectors; distributing system for both street and commercial lighting, step-down transformers, integrating wattmeters; also erection of fireproof brick and reinforced-concrete engine and producer room.

ROSSFORD, OHIO.—The Ford Plate Glass Company, of Toledo, Ohio, is installing a 5000-gal., horizontal, suction, Allis-Chalmers centrifugal pump driven by a 200-hp, three-phase, 40-cycle, squirrel-cage induction motor, manufactured by the Allis-Chalmers Company, of Milwaukee, Wis.

WARREN, OHIO.—Preparations are being made by the Warren City Tank & Boiler Company, of Warren, Ohio, for extensive improvements and extensions to its plant. The company, it is said, will be in the market for three electric traveling cranes and other machinery.

BRISTOW, OKLA.—R. M. House, of Pine Bluff, Ark., and Charles M. Simpson, of Shawnee, Okla., trustees of the Bristow Light & Power Company, have been granted a 25-year franchise and contract. The company will be incorporated with a capital stock of $50,000 and will also install an ice plant. For further information address R. M. House, of Pine Bluff, Ark.

BANDON, ORE.—The City Council, it is reported, will enter into a new agreement with the Bandon Water & Light Company for furnishing the city with water. Under the new agreement a specified amount is to be paid each month, and at the end of five years the city can purchase the plant at a price of which the earnings of the previous year would be 8 per cent.

EUGENE, ORE.—F. B. Kidder and John Baird are interested in a project to construct an electric railway in the vicinity of Eugene, including a line from Eugene to Springfield, and one to Siuslau and Coos Bay and also up the McKenzie Valley.

GRANTS PASS, ORE.—The Rogue River Electric Company has submitted a contract to the Council offering to furnish street lamps for a term of five years. The main portion of the town is to be illuminated with cluster lamps.

PORTLAND, ORE.—Announcement has been made that the Clackamas Southern Railway Company has financed its project and will soon commence work on its proposed electric railway, which will connect Silverton and Oregon City. F. M. Swift, David Loring and A. E. Clark are interested in the enterprise.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 500-kw, 600-volt, 100-r.p.m., vertical-shaft, waterwheel type, direct-current generator, making the seventh machine which the Allis-Chalmers Company has furnished the Portland company during the last two years.

UNION, ORE.—We are informed that Louis C. Kelsey, of Salt Lake City, Utah, has been engaged to prepare plans and superintend the construction of a hydroelectric power plant and water works system for Union, to cost approximately $60,000.

ALLENTOWN, PA.—A meeting of the stockholders of the Lehigh Valley Transit Company will be held in Allentown May 19, to authorize the creation of a $10,000,000 refunding and improvement mortgage; also to authorize the issue of $6,000,000 in bonds, the proceeds of which will be used to retire $2,500,000 of outstanding bonds and $900,000 debenture notes, and the balance to be used for extensions and improvements to its property.

BEAVER, PA.—The question of establishing a municipal electric light plant in Beaver is under consideration. It is estimated that a plant could be installed in connection with the pumping station at a cost of about $30,000, which would supply sufficient electricity to provide for street lamps and supply 5000 incandescent lamps.

BEAVER, PA.—The Beaver County Electric Light Company, recently incorporated, has applied to the Borough Council for a franchise to construct and operate an electric light and power plant in Beaver. The company proposes to take over the plant and holdings of the Valley Electric Company. It is said that improvements will be made to the plant and service. Announcement has been made that a reduction will be made in the price of electricity, to take effect May 1, 1910, as follows: For the first 100 kw-hours per month, 10 cents per kw-hour; from 100 to 200 kw, 9 cents per kw-hour; from 200 to 500 kw, 8 cents per kw-hour; from 500 to 700 kw, 7 cents per kw-hour; from 700 to 1000 kw, 6 cents per kw-hour, and from 1000 to 2000 kw, 5 cents per kw-hour. A discount of 10 per cent is allowed on all bills. The minimum rate will be reduced from $2 to $1 per month. Van Horn Ely is president of the company.

HANOVER, PA.—The Hanover & McSherrystown Street Railway Company expects to place contracts for coal handling machinery in the near future. Robert E. Manley, of Hanover, Pa., is general manager.

KITTANNING, PA.—The power house of the Kittanning & Leechburg Railway Company and the Kittanning Electric Light Company was destroyed by fire April 14, causing a loss of about $200,000. T. A. Moesta is president.

LEECHBURG, PA.—The Pittsburgh & Allegheny Valley Railroad Company will call for bids about May 1 for the construction of its proposed railway between New Kensington and Leechburg. H. A. Waddell, of Leechburg, Pa., is superintendent.

NEW CASTLE, PA.—The New Castle Electric Company has applied to the City Council for a renewal of its street lighting contract for a term of ten years from Dec. 1, 1910. The company is contemplating the construction of a new plant in New Castle. Under the contract submitted the price for arc lamps would be $75 per lamp per year for the first 200 lamps and $70 each for all additional lamps installed, and for lamps installed for the last three years of the contract $75 each per year. It also provides for the company using its present poles, which would prevent the city from compelling it to enter the conduit system.

PHILADELPHIA, PA.—We are informed that the Fairmount Park Transportation Company expects to purchase a new generator and boiler. W. C. Martin, of Philadelphia, Pa., is secretary and treasurer.

PHILADELPHIA, PA.—A contract has been placed by Lummis & Company, of Philadelphia, Pa., with the Allis-Chalmers Company, of Milwaukee, Wis., for electrical machinery for their warehouse, including a 100-kw, 240-volt, 275-r.p.m., direct-current generator, direct connected to a gas engine; three 25-hp, one 30-hp and one 5-hp motors, together with switchboard.

SHAMOKIN, PA.—We are informed that the property of the Shamokin & Coal Township Light, Heat & Power Company has changed hands. Edwin E. Witherby has been elected vice-president and director of the company, and has full charge of the plant. The company proposes to construct a new gas plant immediately, and an entire new distribution system, putting in several miles of mains at once. The company already has a complete and up-to-date electric plant.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company is reported to have purchased the property of the Blue Ridge Electric Railway Company and proposes to use the franchises for an extension from Pen-Mar to Blue Ridge Summit, about three miles distant. George B. Beaver, of Waynesboro, Pa., is president of the Chambersburg, Greencastle & Waynesboro Street Railway Company.

WESCOSVILLE, PA.—Plans are being prepared for extensive improvements at the County Home, at Wescosville, Pa., which will include installation of power plant, fire service, sewage disposal plant, etc. It is expected that bids for the work will be called for in the near future. R. S. Rathbun is engineer in charge.

PAWTUCKET, R. I.—Preparations are being made by the Pawtucket Electric Company to install a 5625-kva, 2300-volt, three-phase, 60-cycle, 1800-r.p.m. Allis-Chalmers condensing steam turbo-generator set, which will be installed in time for service next winter.

WOONSOCKET, R. I.—Contracts have been placed by the Manufacturers Power Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1200-kw, 600-volt, 60-cycle, three-phase, 1800-r.p.m., condensing steam turbo-generator set for its power house in Woonsocket. A 25-kw, impulse, turbine-driven generator and a 22½-kw, 120-volt motor generator set will furnish excitation current. The vacuum will be maintained by an Allis-Chalmers type "C" condenser, the pumps of which will be driven by an impulse turbine.

GREENVILLE, S. C.—The Greenville & Spartanburg Electric Railway Company has awarded the contract for the construction of its proposed railway from Greenville to Spartanburg to W. J. Oliver & Co., of Knoxville, Tenn. H. H. Prince, of Greenville, S. C., is interested in the company.

HURON, S. D.—The Huron Light & Power Company is reported to have been granted a franchise to install a light plant.

PIERRE, S. D.—Preparations are being made by the Dakota Central Telephone Company for the construction of an exchange building in Pierre, to cost $12,000.

KINGSPORT, TENN.—The Clinchfield Portland Cement Company has placed additional contracts with the Allis-Chalmers Company, of Milwaukee, Wis., for three 5-ft. x 6-in. x 22-ft. tube mills, to be driven by motors manufactured by the Allis-Chalmers Company for its new plant.

MORRISTOWN, TENN.—Plans are being considered by the Johnson Chair Company for the construction of a new factory. The plant may be equipped for electric motor drive.

AUSTIN, TEX.—At a special election held April 6 the proposition to rebuild the large dam across the Colorado River was carried. The contract for the construction of the dam has been awarded to the Dumont-Holmes Concrete & Steel Company, of Chicago, Ill., for $1,000,000, subject to ratification by the people.

BELTON, TEX.—The citizens of Solado have taken steps to secure an extension of the Belton-Temple Traction Company's railway from Belton to Solado, a distance of 10 miles. It is proposed to give a free right-of-way and a bonus of $40,000.

CLEVELAND, TEX.—The capital stock of the Cleveland Telephone Company has been increased from $2,000 to $15,000.

DALLAS, TEX.—At an election held April 5 the proposition to issue $100,000 in bonds for construction of an electric light plant was defeated.

FORT WORTH, TEX.—Announcement has been made by the Northern Texas Traction Company that it proposes to make extensions and improvements in Fort Worth and Oak Cliff, a suburb of Dallas, which will involve an expenditure of about $1,000,000.

HANDLEY, TEX.—The Northern Texas Traction Company is contemplating the construction of a new power house at Handley, which will involve an expenditure of about $30,000.

HOUSTON, TEX.—Plans are being prepared by the Frank Eller Company, of Houston, Tex., for an addition to its factory, which will be equipped for electric motor drive.

HOUSTON, TEX.—Plans are being considered for the installation of a new electric power plant at the proposed Rice Institute at Houston, Tex. Dr. Edgar Odell Lovett is at the head of the Rice Institute.

HOUSTON, TEX.—The Galveston-Houston Railway Company has awarded the contract for the construction of 19 miles of roadbed, extending from Clear Creek to Bray's Bayou, to Hartley & Ford, of Bay City.

HOUSTON, TEX.—The Houston Electric Company has accepted a bonus of $27,000 offered by the Western Land Corporation to extend its electric railway through the eastern part of South Houston to La Porte. Surveys are now being made of the route.

MESQUITE, TEX.—B. H. Reid, of Fort Worth, Tex., is reported to be organizing a company to construct electric light and ice plants and water works in Mesquite.

PORT ARTHUR, TEX.—Plans are being considered by the Port Arthur Water Company for the construction of an addition to its power house and the installation of an 800-hp steam turbine and an ice machine.

SAN ANGELO, TEX.—The San Angelo Water Works Company has filed amendments to its charter changing its name to San Angelo Water, Light & Power Company and increasing its capital stock from $150,000 to $225,000.

SAN ANTONIO, TEX.—The San Antonio Gas, Electric & Traction Company is contemplating installing additional equipment in its power house. The company is making extensions to its street railway system.

WASHITA, TEX.—The construction of an interurban electric railway from Pauls Alley, Okla., to Dallas, Tex., via Ardmore, Marietta, Sivells Bend, Gainesville, Whiteboro and Denton, is under consideration. Electricity for operating the railway could be secured from the Washita

Falls power plant. A. E. Perry, president of the Washita Falls Electric Company, is interested in the project.

EUREKA, UTAH.—The Utah County Light & Power Company, of American Fork, Utah, is reported to have petitioned the City Council for a franchise to furnish electricity for lamps and motors in Eureka. John H. Woolton is manager.

OGDEN, UTAH.—It is reported that preliminary surveys for a 180-mile transmission line from Shoshone Falls, Idaho, into Oregon, are being made by a company recently organized by eastern capitalists. Parties interested in the project propose to furnish electricity for the proposed interurban electric railways centering around Ogden. David Eccles is said to be interested in the enterprise.

PROVO, UTAH.—The City Council has passed an ordinance providing for an issue of $200,000 in bonds, of which the proceeds of $110,000 will be used for the construction of an electric lighting plant and $90,000 for improvements to the water works. An election will be held May 24 to submit the proposition to a vote.

SALT LAKE CITY, UTAH.—The County Commissioners have granted Le Grand Young a franchise to construct and operate an interurban railway from Salt Lake City to Holliday.

CAPE CHARLES, VA.—The New York, Philadelphia & Norfolk Railway Company has awarded the contract for the construction of its new shops at St. Charles to the John W. Ferguson Company, of Paterson, N. J. The work will include the installation of a power plant, and it is understood that about $50,000 will be expended for new machinery, which will be equipped for electrical operation. D. S. Newhall, of Philadelphia, Pa., is purchasing agent for the railroad company.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company is planning to double-track its line from Ocean View to Willoughby Spit. E. C. Hathaway is general manager.

STAUNTON, VA.—It is reported that financial arrangements have been completed by J. M. Spotts, president of the Blue Ridge Light & Power Company, for improvements and extensions to the railway and lighting system; the latter will be operated under the name of the Staunton Lighting Company. Contracts for equipment will soon be awarded, including boiler with stack, heater and pumps, switchboard and electric generators with sufficient output to supply 15,000 incandescent lamps of 16 cp.

VERNON, VT.—The Connecticut River Power Company is planning to increase the output of its plant at Vernon, Vt., and extend its transmission lines to Lowell and other large cities in Massachusetts. Rights of way have practically been secured from Lancaster to Lowell. The new line will extend from Lancaster to Shirley, Ayer, Forge Village, North Chelmsford, and from there to Lowell. The company already supplies electricity in Fitchburg and Worcester.

IRONDALE, WASH.—The Seattle Electric Company is installing an electric plant for the Western Steel Corporation in Irondale. The plant will have an output of 500 hp, and will furnish electricity for lamps and motors in this town.

LEWISTON, WASH.—The Lewiston-Clarkston Company is reported to have sold its extensive holdings in this vicinity to the Lewiston-Clarkston Improvement Company, which is capitalized at $2,400,000. It is said that J. P. Graves, who is connected with the Inland Empire Railway, is interested in the new company.

NORTH YAKIMA, WASH.—The Northwestern Corporation, of Portland, Ore., is reported to have purchased the property of the Northwest Light & Water Company, of North Yakima, and the power plant and transmission system through the valley owned by Robert Strahorn, of Spokane, Wash.

PE ELL, WASH.—A party of Aberdeen capitalists, headed by P. S. Locks, have secured valuable water rights on the Chehalis River, near Pe Ell, where it is said an electric light and power plant will be erected. Application will soon be made to the Council for a franchise to operate an electric light system in this town.

PORT ANGELES, WASH.—The City Council has granted Thomas T. Aldwell a franchise to operate an electric light and power system in Port Angeles. The franchise carries with it a contract to furnish the city with 150 hp, for which the city is to pay $500 per month. The proposed plant is to be located on the Elwha River, five miles west of Port Angeles, where it is estimated that 50,000 hp can be developed. The present plans of the company contemplate developing 5000 hp. Under the terms of the franchise the company is to commence work on its plant within six months and to furnish the city with electricity in two years.

SEATTLE, WASH.—The Seattle-Tacoma Short Line, of Seattle, has been granted a franchise to construct an electric railway, 29 miles in length, between Seattle and Tacoma, by the Board of Commissioners of King County. Work on construction of the new line will commence within 60 days.

SOUTH BEND, WASH.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded the contract for furnishing the power equipment for the new mill of the Kleeb Lumber Company, which will be equipped for electric motor drive throughout. The machinery will include a 500-kw, 480-volt, 60-cycle, three-phase, 3600-r.p.m., alternating-current, steam turbo-generator set, a surface condenser for maintaining vacuum, a 15-kw, 120-volt, motor-generator exciter set, a three-panel switchboard, with necessary controlling apparatus, and 22 induction motors, ranging from 5 to 200 hp for driving machinery in mill.

SPOKANE, WASH.—The City Council is said to be considering the question of ornamental illumination of the principal business streets in the city.

SPOKANE, WASH.—The Manito Boulevard Improvement Club is reported to be considering the question of placing electroliers on Manito Boulevard.

SPOKANE, WASH.—The Washington Southern Telephone Company has filed an amendment to its charter increasing its capital stock from $600,000 to $700,000. The company has made arrangements with the Home Telephone Company, whereby it can enter the city on the wires of the Home Company, and the last-named company will operate in the country over the lines of the Washington Company. The Washington Southern Company proposes to eventually extend its service to the coast, and will also extend its lines to Portland, Ore. Charles M. Cooley and D. V. Cushman, of Spokane, Wash., are among the directors.

TENINO, WASH.—The Tenino Light, Power & Water Company has commenced work on construction of its hydroelectric power plant on the Skookumchuck River, located about 15 miles from Tenino. The plant will develop about 2000 hp, which will be transmitted to Tenino, Centralia and Chehalis. The cost of the plant is estimated at about $182,000.

BORDERLAND, W. VA.—The Borderland Coal Company is contemplating the installation of an electric hoist and other machinery at its coal mines in the near future.

MORGANTOWN, W. VA.—The county court has granted H. R. Warfield, manager of the Union Utility Company, a franchise to extend the Sabraton Railway to Cheat River and the Pennsylvania State line via Dellslow. The company also proposes to extend the Morgantown & Pittsburg Railway to Granville.

ELKHORN, WIS.—The contract for construction and furnishing equipment for power house, and installing heating, lighting and ventilating systems in the Walworth County Poor Farm and Insane Asylum, has been awarded to Downey & Kruse Company, of Milwaukee, Wis., for $24,173. Grant Harrington, of Elkhorn, Wis., is county clerk.

CHEYENNE, WYO.—The Commercial Club of Cheyenne has accepted a proposition for the construction of an electric railway from Oklahoma City, Hobart and Sayre to Cheyenne. It is proposed to furnish free right-of-way through the county and a $35,000 bonus, to be paid when the railway is completed into Cheyenne.

WHEATLAND, WYO.—At an election held recently the citizens voted in favor of the proposition to erect water works, electric light plant and sewer system to be owned and operated by the municipality. A bond issue of $75,000 was also voted, the proceeds to be used to commence work on construction of the three systems, which will begin as soon as possible.

EDMONTON, ALTA., CAN.—At an election to be held April 21 the by-laws to issue $30,000 debentures for extensions and improvements to the municipal electric light system; to issue $260,000 in debentures to extend and purchase equipment for the municipal street railway system, and also to issue debentures to the amount of $60,000 for the erection of car barns for the municipal street railway, were carried.

BRANDON, MAN., CAN.—The city engineer is preparing plans for establishing a municipal electric power plant. It is proposed to install a steam generating plant with sufficient output to supply electricity to operate a street railway system, the pumping station and for street lighting. The cost of a 1000-hp plant is estimated at $125,000, and the installation of underground piping for steam heating would cost $60,000 additional.

WINNIPEG, MAN., CAN.—Bids will be received by the Chairman of the Board of Control until April 30 for supply of arc lamps and regulating apparatus, switchboards and accessories, insulated line wire and mast arm parts. Specifications and conditions governing bids may be obtained at the office of the city electrician. M. Peterson is secretary of Board of Control.

BERLIN, ONT., CAN.—The by-laws to grant the People's Railway Company a franchise to build an electric railway over certain streets in the city and to take $60,000 in preferred stock of the company were carried at a recent election. The company proposes to construct radial branches to New Hamburg, Wellesley, New Dundee and Breslau.

GALT, ONT., CAN.—The City Council has purchased the distributing system of the Galt Gas Company for $16,500. Preparations are now being made by the fire and light committee for the distribution of electricity to be furnished by the Hydro-Electric Power Commission.

INGERSOLL, ONT., CAN.—A by-law to provide for the purchase of the plant and holdings of the Ingersoll Electric Power & Light Company will soon be submitted to the ratepayers. The arbitrators have fixed the price at $37,225.

RENFREW, ONT., CAN.—It is understood that a by-law will soon be submitted to the ratepayers, asking for $77,000 for the development of water powers.

STRATFORD, ONT., CAN.—At an election held April 14 the by-law to appropriate $85,000 for the construction of a distributing system for Niagara power was carried.

TORONTO, ONT., CAN.—The Safety Insulated Wire & Cable Company, of New York, N. Y., has been awarded the contract for laying conduit at the railroad crossings in Toronto, Can., for $11,387.

MOOSE JAW, SASK., CAN.—The City Council has entered into an agreement granting an Ottawa company an exclusive street railway franchise in Moose Jaw, subject to the approval of the ratepayers. The fran-

chise is for a period of 20 years, and under its terms the company is to have three miles of the proposed railway in operation this year and before the end of 1911 an additional three miles. The initial cost is estimated at $175,000. A. A. Dion, of Ottawa, is interested in the project.

MORELIA, MICHOACAN, MEX.—Application has been made to the Federal Government by George Pinson for a concession of water rights on the Zitacuro River, to be utilized to generate electricity. Mr. Pinson and associates propose to erect a hydroelectric power plant and to erect transmission lines to Morelia and a number of other towns and industrial centers to supply electricity.

EL TIGRE, SONORA, MEX.—Announcement has been made that the plans of El Tigre Mining Company not only provide for the construction of a large hydroelectric power plant on the Buaispe River, but also include the building of an electric railway to run between the mines and reduction works of the company in El Tigre district and Douglas, Ariz., a distance of about 75 miles. The location of the hydroelectric plant has not yet been decided upon.

MERIDA, YUCATAN, MEX.—Local capitalists are interested in a project to construct an electric railway to extend from Merida to the ruins of Uxmal.

## New Industrial Companies.

THE ATLANTIC VACUUM CLEANERS COMPANY, of Jersey City, N. J., has been incorporated by A. M. Everett, W. W. Graham and J. F. Autenrieth, of Jersey City, N. J. The company is capitalized at $50,000 and proposes to manufacture vacuum cleaners.

THE BEARINGS COMPANY OF AMERICA, of Jersey City, N. J., has been chartered with a capital stock of $1,000,000 by W. B. Greeley, J. W. Hertzler, A. L. O'Shea, E. F. Roehm, of New York, N. Y., and T. A. Henwick, of Greenville, Jersey City, N. J. The company proposes to manufacture bearings, balls, ball retainers, magnetos, carbureters, etc.

THE BURNHAM & IVES COMPANY, of Bloomington, Ill., has been chartered by C. H. Burnham, Frank W. Ives and Charles B. Ives Company, of Bloomington, Ill. The company is capitalized at $10,000 and proposes to do a general engineering and construction business.

THE FACKNER-COATES CONSTRUCTION COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $40,000 as general contractors, civil, electrical and sanitary engineers. The incorporators are: E. Fackner, C. B. Coates, of Brooklyn, N. Y., and C. B. Sagar, of Richmond Hill, N. Y.

THE FEDERAL RAILWAY EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000 to manufacture and deal in railway supplies and equipment. The incorporators are: J. N. Drake, of New York, N. Y.; R. C. Swan and J. W. Fowler, of Brooklyn, N. Y.

THE HYDRO-TELE-MOTOR COMPANY, of New York, N. Y., has been chartered by J. W. McKay, of Brooklyn, N. Y.; H. F. Fisher, of New York, N. Y., and E. E. Cole, of Hoboken, N. J. The company is capitalized at $25,000 and proposes to manufacture and deal in power transmission machinery.

THE OUACITA DEVELOPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 to construct railroads, bridges, buildings, etc., by Perry Tiffany, Lloyd W. Crawford, and Daniel F. Whitney, of New York, N. Y.

THE P. P. VALVE COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by M. A. Courtland, C. L. Wooley and D. E. Fitch, all of New York, N. Y. The company proposes to manufacture and deal in gas and electric lighting supplies; manufacture and deal in gas fixtures, electroliers, etc.

THE REX ELECTRICAL SUPPLY COMPANY, of Joplin, Mo., has been incorporated with a capital stock of $10,000 by R. M. Camblin, O. W. Barger and R. L. Meredith.

THE SIMPLEX ELECTRIC HEATING COMPANY, a Massachusetts corporation, has filed articles of incorporation with the Secretary of State, Springfield, Ill. The company is capitalized at $160,000 and proposes to manufacture machinery.

THE SOUTHWORTH MACHINE COMPANY, of Portland, Maine, has been incorporated with a capital stock of $100,000 to deal in machinery of all kinds. E. Southworth is president of the company; C. Southworth treasurer, and C. S. Cook clerk, all of Portland, Maine.

THE STOUGHTON MILLS, of Kittery, Maine, has filed articles of incorporation with a capital stock of $75,000 for the purpose of manufacturing machinery of all kinds. The incorporators are: H. P. Knowlton and E. J. Burnham, both of Malden, Mass.

## New Incorporations.

SACRAMENTO, CAL.—The California Northern Telephone & Telegraph Company has been incorporated with a capital stock of $100,000 for the purpose of operating in the northern part of California. The directors are: Scott Hendricks, of San Francisco, Cal.; W. H. Bissell, of Livermore; W. E. Ellis, Arthur Matthews, Grant Smith, M. C. Colby and J. O. McElroy, all of San Francisco, Cal.

COLUMBUS, GA.—The Columbus Power Company, of Columbus, Ga., has filed articles of incorporation with the Secretary of State at Montgomery, Ala. The Alabama headquarters of the company will be in Phoenix City. Warren Williams is agent. The company is capitalized at $1,800,000, and proposes to develop the water power of the Chattahoochee River to be utilized to generate electricity, which will be transmitted to towns and cities in Alabama and Georgia. The incorporators are: John F. Flournoy, Louis F. Gerrard, Arthur A. Wilbur, Frank W. Gerrard, Frank A. Reidhead and Reynold Flournoy.

LATHAM, ILL.—The Latham Telephone Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are: J. W. Collins, H. S. Bekmeyer, J. S. Heller and P. E. Kuhl.

LINTON, IND.—The Linton Mutual Telephone Company has been chartered with a capital stock of $10,000. The directors are: David R. Scott, George E. Chapman, Thomas E. Harris, Likens Littell and Warren Tinstman.

KINDER, LA.—Articles of incorporation have been filed for the Kinder Ice, Light & Water Company with a capital stock of $25,000. The officers are: Paul O. Moss, president; John R. Lyles, vice-president, and H. A. Keyes, secretary and treasurer.

BUTTE, MONT.—The State Telephone & Telegraph Company has been organized by John Stedman and others with a capital stock of $500,000 to construct telephone, telegraph and electric transmission lines. The capital stock of the company is placed at $500,000.

BOLEY, OKLA.—The Boley Light & Power Company has been chartered with a capital stock of $5,000 by D. J. Turner, T. M. Haynes, W. H. Sims and others.

OMEGA, OKLA.—Articles of incorporation have been filed for the Omega Telephone Company by Benjamin F. Smith, W. T. Morris, J. C. Smith, F. H. Leech and John E. Wood. The company is capitalized at $5,000.

YELTON, OKLA.—The Ditch Valley Telephone Company has been incorporated with a capital stock of $25,000 by William Little, Wolf and Jacob Dale, of Englewood, Kan., and O. W. Mundall, of Yelton, Okla.

EBENEZER, PA.—The Ebenezer Telephone Company has been chartered with a capital stock of $5,000 to operate a telephone line from Orangeville to Berwick. C. A. Small is solicitor for the company.

SENECA, S. C.—Articles of incorporation have been filed for the Seneca Light & Power Company by G. W. Gigniliat, L. A. Edwards, Campbell Courtney and W. A. Strother. The company is capitalized at $50,000.

SUMMERVILLE, S. C.—The Summerville Ice, Light & Power Company has been incorporated with a capital stock of $25,000. The officers are: John H. Heinsohn, president and treasurer, and Julius D. Koster, secretary.

DRAPER, S. D.—The State Telephone Company has been organized by Charles Parker, J. C. Russell and Elmer Seapy. The company is capitalized at $5,000 and proposes to construct a telephone line to Wendt.

FORNEY, TEX.—The Forney Electric Company has been chartered with a capital stock of $10,000 by Yancey McKellar, J. M. Davis, Jr., J. C. Gardner and others.

FRANKLIN, TEX.—The Franklin Telephone Exchange has been incorporated, with a capital stock of $5,000, by R. W. Cole, F. S. Estes, R. M. Cole and J. L. Goodman.

STAUNTON, VA.—The Staunton Lighting Company has been incorporated with a capital stock of $150,000. The officers are: John M. Spotts, president; C. B. Trenor, vice-president and secretary.

SEATTLE, WASH.—Articles of incorporation have been filed for the Nespelem Falls Power Company by James B. Callahan, William Kingsley and John Arthur. The company is capitalized at $50,000.

## Personal.

*MR. J. A. SNOOK*, of the Ft. Logan Electric Works, presented a paper on April 14 before the Ft. Wayne A. I. E. E. Section, entitled "Regulation of Switchboard Instruments."

*DR. LOUIS BELL* is the author of a paper entitled "Star Colors: A Study in Physiological Optics," which appears in *The Astrophysical Journal*, No. 3, April, 1910.

*MR. HORACE E. ANDREWS* has announced his resignation as president of the Cleveland Railway Company, in order to devote his entire time to his financial interests in New York.

*MR. JESSE O. TOBEY*, formerly division foreman of the Pacific Gas & Electric Company, has been appointed superintendent of the Sacramento (Cal.) Electrical Division for the company.

*MR. H. N. MULLER*, who for the past five years has been electrical engineer of the Allegheny County Light Company, Pittsburg, Pa., has been made superintendent of distribution for the company.

*MR. S. S. WYER*, of Columbus, Ohio, has been retained by the village of New Concord, Ohio, to prepare plans for and to superintend the construction of a municipal electric lighting plant for that village.

*MR. EDWARD B. MOORE*, Commissioner of Patents, has been appointed as expert attaché to represent the United States at the fourth international conference of American States, to be held at Buenos Ayres, July 9.

*MR. H. H. WOODS* has been appointed sales manager of the Illinois Appliance Company, which manufactures an adaptable lamp changer. This company has lately removed its offices from the First National Bank Building to 167 Dearborn Street, Chicago.

*MR. WILLIAM G. DAVIS,* formerly manager of the New York office of the Westinghouse Storage Battery Company, has temporarily given up his personal affairs to administer the estate of his father, Mr. E. G. Davis, of Washington, D. C., who died March 22.

*MR. FRANK J. BAKER,* vice-president of the North Shore Electric Company, Chicago, has been named as one of the directors of the new La Salle Street National Bank and La Salle Street Trust Company of Chicago—financial institutions promoted by Senator William Lorimer.

*MR. EDWIN E. WITHERBY* has acquired control of the Shamokin & Coal Township Light, Heat & Power Co., Shamokin, Pa., of which he has been elected vice-president. Both the gas and electric plants will be thoroughly brought up to date, though the latter will require little improvement, being already in excellent condition.

*MR. H. H. JONES,* who recently became manager of the San Diego (Cal.) Consolidated Gas & Electric Company, formerly served as superintendent of the Springfield (Ill.) Light, Heat & Power Company. Mr. C. E. Groesbeck, whom Mr. Jones succeeded, has been made Pacific Coast manager for H. M. Byllesby & Company, of Chicago.

*MR. JOHN C. PARKER,* industrial engineer of the Rochester Railway & Light Company, addressed the salesmen of the Toronto Electric Light Company on "Industrial Engineering," April 15. Mr. Parker was in Toronto for the purpose of making an address before the local section of the A. I. E. E., and consented to address the members of Mr. Creed's department.

*MR. ARTHUR BESSEY SMITH,* one of the engineers of the Automatic Electric Company, Chicago, addressed the electrical students of Purdue University, Lafayete, Ind., recently on "The Automatic Telephone System." The lecture was illustrated by lantern-slide pictures and a demonstration of working apparatus. Mr. Smith was formerly professor of telephone engineering at Purdue.

*MR. I. A. BENNETT,* of the I. A. Bennett Company, Chicago, has been appointed sales manager of the Sangamo Electric Company, of Springfield, Ill. Mr. Bennett, who is an active, energetic member of the electrical fraternity in Chicago, with a wide acquaintance, was formerly sales manager of the Electric Appliance Company of that city. He will have full charge of the sales of the Sangamo Electric Company, including advertising and publicity work, and for the present will divide his time between Chicago and Springfield.

*DR. HENRY VETILLART,* inspector general of public works, France, is visiting this country under a commission from the Minister of Public Works, to report on a plan by which the French Government proposes to send yearly a number of young engineers to the United States to familiarize themselves, at first hand, with American engineering and manufacturing methods. Dr. Vetillart's present itinerary will include New York, Chicago, Philadelphia, St. Louis, Pittsburgh, Boston, Schenectady and Buffalo, and his efforts will be especially directed to enlisting the co-operation of leading manufacturing, transportation and mining corporations and prominent engineers. Under judicious administration the project promises to be of mutual advantage to both countries concerned. Dr. Vetillart has rendered conspicuously distinguished service on river and harbor improvement works in France. He received the honorary degree of Doctor of Science in 1907 from the University of Pennsylvania, on the occasion of the dedication of the new engineering building, which he attended as the special representative of his government.

## Obituary.

*DR. WILLIAM A. TICHENOR* committed suicide in a Chicago hotel on April 7. Dr. Tichenor, who was a retired physician, 50 years of age, was interested in electrical inventions and left a letter in which he spoke of "an unfortunate venture in the battery business in which I lost practically everything I had." It is also believed that the dead man was greatly discouraged by the failure of an electric railway scheme which he had been promoting in Michigan, as well as other financial losses. The coroner's jury reported that Dr. Tichenor ended his life by means of "an unknown narcotic poison."

## Trade Publications.

ELECTRICAL SUPPLIES.—The Harvard Electric Company, Chicago, Ill., have just issued a new edition of its supply catalog.

SMALL MOTORS.—Bulletin No. 5360, of the Western Electric Company, describes a line of small motors for direct current and alternating current operation.

VITRIFIED CONDUIT.—A neat little booklet describes and gives the uses of the vitrified clay conduit made by the H. B. Camp Company, New York City.

VACUUM CLEANER.—A single folder describes, illustrates and gives the price of the cleaner and attachments made by Hanlon & Wilson, Wilkinsburg, Pa.

MOTORS AND GENERATORS.—Bulletin No. 193 describes the line of small motors, generators and motor-generator sets made by Roth Bros. & Company, Chicago, Ill.

CABLE ROLLERS.—A mailing card upon which instructions for stringing aerial cable by means of cable rollers is issued by W. N. Matthews & Brother, St. Louis, Mo.

VENTILATING FANS.—A new catalog has been issued by the Ilig Electric Ventilating Company, Chicago, Ill., in which the fans are described, the methods of calculation explained and prices given.

LINE CONSTRUCTION TOOLS.—A bulletin, No. 7F, issued by Mathias Klein & Son, Chicago, Ill., illustrates, describes and gives prices of all kinds of tools and appliances required in the construction of pole lines.

STREET LAMPS AND FIXTURES.—The Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa., has published an illustrated price list and catalog of its tungsten arc lamps and fixtures for street lighting.

ELECTRIC MACHINERY.—A small folder, issued by the Crocker-Wheeler Company, Ampere, N. J., illustrates different types of generators and motors in service. There is no descriptive matter other than the titles of the illustrations.

VACUUM CLEANER.—A multiple folder published by the Duntley Manufacturing Company, Chicago, Ill., describes different types of cleaners and special attachments, and the illustrations show the uses to which the apparatus may be put.

INDUCTION MOTORS.—A line of polyphase induction motors arranged to start as repulsion motors and automatically shift to induction motor with short-circuited secondary is described in bulletin No. 89 of the Wagner Electric Company, St. Louis, Mo.

HOT AIR BLAST HEATING SYSTEM.—The American Blower Company, Detroit, Mich., has issued bulletin No. 273, which describes its hot blast system of heating and ventilation and gives directions and tables for calculating the size of equipment required for a given service.

TECHNICAL BOOKS.—A classified catalog of engineering books, in three parts: Part I, Electrical Engineering and Electric Railways; Part II, Mining and Metallurgy; Part III, Civil and Mechanical Engineering, was recently issued by the McGraw-Hill Book Company, New York City.

GLASS REFLECTORS.—Catalog D, of the Phœnix Glass Company, New York City, describes a line of reflectors made of a high-grade, pure white marble glass, under the trade name of Pheno reflectors. Some notes regarding correct methods of illumination for different classes of service are also given.

EXCESS INDICATOR.—The Excess Indicator Company, Lynn, Mass., has issued bulletin No. 1002, which describes the use and construction of the indicator, which is used to control the maximum demand of a flat rate customer. Statistics on the controlled flat rate charging system as worked in this country are also given.

STORAGE BATTERIES ON ALTERNATING CURRENT SYSTEMS.—The battery equipment of the Gary plant is described in detail in bulletin No. 121, of the Electric Storage Battery Company, Philadelphia, Pa. This battery is used with variable ratio split-pole converters to neutralize fluctuations in the alternating current system.

BEARING METAL.—A neat and instructive booklet, issued by Joseph T. Ryerson & Son, Chicago, Ill., describes a special alloy metal Glyco, giving its characteristics and physical constants. The book also contains useful tables and instructions for calculating bearing stresses, friction, etc. This bulletin is No. 13 of the Technical Library Series.

INDUSTRIAL RAILWAYS.—An 80-page booklet of the C. W. Hunt Company, New York City, is devoted to a description of its system of industrial railways, including track, construction cars and locomotives. The system is discussed at length from the economy and design standpoint. A great variety of applications of the Hunt system to all sorts of conditions are illustrated.

CRANES AND I-BEAM TROLLEYS.—Bulletin No. 17 of the Pawling & Harnischfeger Company, Milwaukee, Wis., describes a line of hoisting and transporting devices, involving the use of I-beam track and I-beam trolleys. These trolleys may be had with or without travel gear, and the latter may be arranged for hand or electric drive. Electric traveling cranes of the usual type are also described.

VIBRATOR.—A booklet, issued by the American Vibrator Company, St. Louis, Mo., is intended for doctors to distribute among their patients. It describes the uses to which the vibrator may be put, giving a list of the diseases treated and the special attachments required. Another booklet published by this company describes the use of the vibrator in the home for massaging different parts of the body.

BELT DRIVEN GENERATORS.—The Western Electric Company has recently issued a bulletin describing its type EC belt driven Hawthorn generators. A complete description of the construction and operation of its generators is given, with illustrations of the different types. Considerable space is given to a description of the individual parts of these generators. The number of this bulletin is 5132-1.

ELECTRIC INSTRUMENTS.—The Roller-Smith Company, New York City, have issued a bulletin describing a new ammeter and voltmeter set for use on automobiles. The set consists of two moving coil type movements mounted in one case with an electric lamp. The movement is spring supported to protect the jewel from shocks. The description is clear and complete and the uses of the ammeter and voltmeter on automobiles are discussed and explained.

FLAME ARC LAMPS.—With this title the General Electric Company has issued a publication (Bulletin No. 4717) devoted to the use of the G. I. flame arc lamp, for the lighting of streets and large interiors. The lamps described are designed to operate two in series on 110 volts, alternating or direct current; four in series on 220 volts, alternating or direct current; ten in series on 550 volts, alternating or direct current; direct-current series 9.6 amperes, alternating-current series 4 to 7.5 amperes. The description of various lamps is taken up in detail and will prove of interest to central station men.

## BUSINESS NOTES.

THE PEERLESS-V-BELT COMPANY will move from 334 South Clinton Street, Chicago, to 541 Jackson Boulevard, Chicago, Ill., about May 1.

THE BOSTON BELTING COMPANY has opened a store at 177 Lake Street, Chicago, with Mr. M. S. Curwen, manager of sales, in charge, where a complete assortment will be carried of rubber belting, hose, packing and other mechanical rubber goods.

VAUGHN & MEYER.—Mr. Francis A. Vaughn, formerly with the Milwaukee Electric Railway & Light Company, and Mr. Hans J. Meyer, formerly with the Westinghouse Electric & Manufacturing Company, have opened offices as consulting electrical engineers, under the firm name of Vaughn & Meyer, at 909 Majestic Building, Milwaukee.

THE LOWE ELECTRIC COMPANY, of Macon, Ga., recently formed, is successor to the Southern Electric Supply & Manufacturing Company, which did a general electrical engineering and contracting business, and also dealt in electrical and combination fixtures, supplies and machinery. H. E. Lowe is president and general manager of the company.

THE NATIONAL ELECTRIC WORKS, of Whittier, Cal., have opened a general sales office at 46 Van Buren Street, Chicago, in charge of Mr. C. D. Carter, sales manager. This company manufactures the National interior fire-alarm system, which is installed in a number of schools and factories on the Pacific Coast and is being introduced in the Central West and the East.

WISCONSIN ENGINE COMPANY, Corliss, Wis., is installing in the billet mill of the American Rolling Mill Company at Middletown, Ohio, a 48-in. x 60-in. Corliss engine. The engine is heavily constructed throughout and will have a 200,000-lb. fly-wheel. It is built for a steam pressure of 150 lb. and to run at a speed of 85 r.p.m. The engine is provided with a hollow-forged steel piston rod with a tail crosshead support, so that the piston, which is made of open-hearth cast steel, will not come in contact with the cylinder. The valve gear is operated by double eccentrics and is of the long range type, enabling the engine to take a very heavy overload. The frame is made in one piece and is of massive construction to withstand the shocks from the mill.

# Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 12, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

954,340. LOCK-OUT DEVICE FOR PARTY TELEPHONES; D. W. Kneisly, Dayton, Ohio. App. filed April 27, 1908. For selective talking in which the instruments of a party line are operated by separate impulses from central, each instrument being released or thrown in by a different number of impulses. The receiver hooks of the unused telephones are locked by means of a pivoted lever with a variable stop.

954,434. MEANS FOR SUPPRESSING THE RESISTANCE OF THE NEGATIVE ELECTRODE FLAME IN ELECTRIC VAPOR APPARATUS; P. C. Hewitt, New York, N. Y. App. filed March 21, 1902. Makes use of a solid electrode extension projecting from the negative electrode whose surface forms an oblique angle with reference to the surface of the liquid negative electrode.

954,445. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed Dec. 10, 1908. For trains in which a metallic circuit includes a number of telephones and additional circuits in tandem are non-interfering. A large number of repeating coils is avoided and connected ringers with polarized magnets enable the sets of the second group to signal each other selectively.

954,448. TERMINAL FOR PUSH BUTTON ELECTRIC SWITCHES; N. Marshall, West Newton, Mass. App. filed Sept. 21, 1909. The terminal has a contact blade and binding post in a single piece and of standard section with the ends bent at right angles and perforated.

954,461. PUSH SWITCH; J. G. Peterson, Hartford, Conn. App. filed April 28, 1909. A double push button switch with the usual receptacle and with a shaft, a rocker and pole carrying and locking plate on the shaft, together with a latch plate and spring.

954,462. ELECTRIC SWITCH; J. G. Peterson, Hartford, Conn. App. filed May 18, 1909. Commutator of a snap rotary switch which, when it opens the circuit, interposes insulating material between the poles, such as a yielding insulating disc.

954,463. ELECTRIC SWITCH HANDLE; J. G. Peterson, Hartford, Conn. App. filed Aug. 31, 1909. For rotary snap switches with yielding stems for rotating the spindles and holding the covers or face plates firmly into position regardless of variations in the parts.

954,468. WINDING FOR ELECTRIC MACHINERY; H. Rosenberg, Vienna, Austria-Hungary, and E. Rosenberg, Berlin, Germany. App. filed June 17, 1904. A single armature with two fields giving current of the same polarity for either direction of rotation, the first field being excited in a constant direction and influenced by a current derived from the brushes appertaining to the second field, and the second field being excited by current from the short circuited winding of the armature.

954,475. ELECTRIC LOCOMOTIVE; F. L. Sessions, Columbus, Ohio. App. filed March 1, 1904. A cable reel attachment for running locomotives, the reel being provided with a brake which holds it against rotation in one direction only.

954,489. PRINTING TELEGRAPH; J. E. Wright, New York, N. Y. App. filed May 14, 1907. Column printing telegraph doing away with one transmission line, making use of a type wheel with a plurality of circles of type which is rotated step by step and moved along the line step by step and actuated by independent electromagnets included in the same circuit and actuated by positive and negative impulses.

954,493. DAMPER REGULATOR; C. Ambruster and H. McK. Beck, Chicago, Ill. App. filed Jan. 12, 1906. For regulating furnace drafts by means of a thermostat and cranks connected to dampers with a weight revolving the crankshaft and a stop holding the shaft.

954,508. MECHANICAL CONTROLLER; H. W. Forslund, Chicago, Ill. App. filed June 27, 1907. For electrical hoisting machinery with improvements in the controller brushes so arranged that the brushes forming the circuit closers must be thrown into full contact before the motor starts.

954,518. ALTERNATING CURRENT TRANSFORMER; H. A. Keip, Rochester, N. Y. App. filed Oct. 1, 1908. For transforming lighting current into medical current by means of a pair of insulators, a plug with two contacts, a preliminary coil, a secondary coil, with a longitudinal series of contacts, tie rods and a contact device guided on one of them.

954,537. ELECTRICAL CUT-OUT; P. J. McDonald, Rochester, N. Y. App. filed March 18, 1908. An insulating base having a bore, an annular depression at one end of the bore, a contact within it, a ring contact in the annular depression and a movable connector for connecting the contacts.

954,586. AUTOMATIC SIGNAL DEVICE; F. Porton, Baltimore, Md. App. filed March 19, 1909. For railway block systems and for applying the brakes automaticilly and also notifying the tower man. Details.

954,590. INSULATOR; A. L. Stadermann, Terre Haute, Ind. App. filed Aug. 19, 1907. For running wires, in which two or three wires may be twisted together and the insulator knob has a plurality of grooves and consists of a plurality of knobs radiating from a stem.

954,597. INSULATING DEVICE; Jan Steynis, Babylon, N. Y. App. filed March 29, 1909. For the production of ozone in which hollow electrodes are alternately grounded, the remaining ones being insulated and a liquified gas is prevented from constituting a conducting path.

954,599. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed June 12, 1907. For axle lighting system for cars in which two dynamos and switching mechanisms are used to connect the field winding of one dynamo in the circuit of the other dynamo or in the circuit of both dynamos, and also a battery is used for exciting one of the dynamos.

954,614. ARMATURE WINDING; F. Conrad, Swissvale, Pa. App. filed Nov. 3, 1906. For alternating current motors, particularly single phase motors started as commutator motor and running as induction motors by short circuiting the winding. The terminals of the groups of coils that are in the respective core slots and disposed correspondingly with the respective poles of like polarity, when operating as a commutator motor are connected by cross connectors.

954,619. INSTRUMENT FOR DETECTING ELECTRIC OSCILLATIONS; J. A. Fleming, London, England. App. filed Jan. 2, 1909. An electric glow lamp carrying a metal plate or cylinder on an insulator terminal constituting a rectifier, one electrode being composed of tungsten and one element of carbon.

954,624. COMBINED JACK AND RESTORING TRIP; E. J. Grenier, Menominee, Mich. App. filed Nov. 9, 1907. The electro magnet controlling the shutter can be removed without dismembering the device. Details.

954,640. APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, England. App. filed March 31, 1909. A transmitter in which two parallel discs are rapidly rotated in opposite directions and carry studs and the discharge takes place between them.

954,641. WIRELESS TELEGRAPHY; G. Marconi, London, England. App. filed May 15, 1909. For duplex wireless telegraphy in which the aerial is rapidly and successively connected to the transmitting and receiving circuits and synchronism between the instruments at the two stations is avoided by arranging the operative periods of the transmitting apparatus considerably shorter than those of the receiving apparatus. Makes use of a transmitter of 954,640.

954,642. ELECTRIC RECEPTACLE; N. Marshall, Newton, Mass. App. filed May 27, 1909. For making connections with wires in grooved moldings by means of a receptacle having a porcelain base block over which the contact wires may be bent, terminal plates thereon, a porcelain cover therefor and other details.

954,656. ELECTRIC SIGNAL SYSTEM; A. L. Sohm, Los Angeles, Cal. App. filed May 25, 1908. An electric call system in which an indicating pointer is operated by a handle transmitting the signal and returning the signaling element to normal position. A single stroke bell at central gives the signal.

954,695. ADJUSTABLE CASING FOR ELECTRIC LAMP SOCKETS; C. D. Platt, Bridgeport, Conn. App. filed Jan. 24, 1910. A two-part shell with a lock for holding the parts together throughout their periphery.

954,701. AUTOMATIC TELEPHONE; J. E. Rogers, Danbury, Conn. App. filed Nov. 18, 1909. An automatic telephone with a hollow

stem, a pair of arms carrying receivers, a transmitter telephone on the stem and springs carried by the stem connected to the circuits and controlled by the receiver hook.

954,710. SAFETY CONTROLLING DEVICE FOR STREET CARS; E. D. White, New York, N. Y. App. filed Aug. 23, 1909. The propelling mechanism of the car is rendered inoperative while a passenger is passing over the steps by cutting out the motor current through electro-pneumatic devices operated by the weight of the passenger on the step.

954,714. SYNCHRONIZING ATTACHMENT FOR CLOCKS; P. E. Burns, Syracuse, N. Y. App. filed Feb. 26, 1908. An escapement arbor with a lug, a bifurcated lever engaging the lug alternately and actuated by an electro-magnet and an adjustable stop arm in rigid connection with the lever.

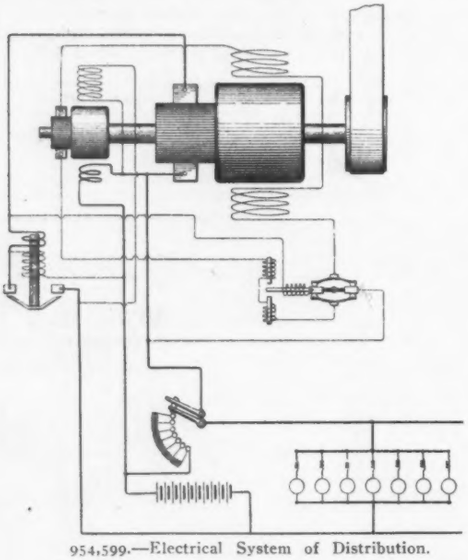
954,715. DIAPHRAGM FOR ACOUSTIC APPARATUS; W. Burstyn, Berlin, Germany. App. filed Feb. 19, 1909. Makes use of an annular case clamping a diaphragm at its circumferences with rigid means for supporting it at the center and a layer of carbon powder between the loaded diaphragm and between the center and circumference.

954,716. CIRCUIT CONTROLLER; S. Cabot, Brookline, Mass. App. filed May 6, 1909. A sonorous circuit, an alternating current source and a circuit controller or discharger having two sets of electrodes, one set giving equally spaced discharges for each half cycle of the alternating current, with means for creating relative motion between the sets of electrodes in synchronism with the source of alternating current for wireless transmitters.

954,724. STARTER FOR ELECTRIC MOTORS; K. Von Dreger, Berlin, Germany. App. filed July 11, 1908. For liquid retarders or dash pots for electric starting switches in which the brake piston is coupled with the switch lever during the switching-in movement and disconnected during the switching-off movement.

954,734. COMBINED TELEPHONE AND TELEGRAPH SYSTEM; G. E. Hiner, New York, N. Y. App. filed May 15, 1908. Eliminates the static discharge by impressing on the telephone line, rounded telegraph waves shading the impulses at the beginning and at the end, the waves being of such low frequency as to have no effect upon the diaphragms of the telephone.

954,745. ALTERNATING CURRENT ELECTROMAGNET; L. Larsen, New York, N. Y. App. filed May 25, 1907. The number of the effective turns of the magnet is varied so that the maximum magnetic density in the coil is established during a movement of a part while the device actuated by the magnet is thrown into action and is reduced while the device is held in action.



954,599.—Electrical System of Distribution.

954,766. ABRASIVE MATERIAL AND METHOD OF MAKING IT; L. S. Saunders, Niagara Falls, N. Y. App. filed Dec. 26, 1908. Melts in an electric furnace, the oxide of aluminum, titanium and iron.

954,767. COMPOSITION OF MATTER CONTAINING OXIDES OF ALUMINUM AND TITANIUM; L. E. Saunders, Niagara Falls, N. Y. App. filed Jan. 14, 1909. An abrasive compound consisting of the oxides of aluminum and titanium, resulting from fusion in an electric furnace.

954,768. COMPOSITION OF MATTER CONTAINING OXIDES OF ALUMINUM, SILICON AND TITANIUM AND METHOD OF MAKING SAME; L. E. Saunders, Niagara Falls, N. Y. App. filed Jan. 14, 1909. An abrasive compound consisting of the oxides of aluminum, silicon and titanium and free from iron oxide.

954,804. INDUCTION FURNACE; K. A. F. Hiorth, Christiania, Norway. Ap. filed Nov. 20, 1906. An annular hearth with one or more bridges to decrease the sectional area of the annulus of the molten charge and an electrode dipping into the slag on each side of the bridge, and a current conductor between the electrodes, causing an electric current to pass from the metallic charge on one side of the bridge to the metallic charge on the other side of the bridge.

954,808. ELECTRIC FURNACE PRODUCT AND METHOD OF MAKING SAME; G. N. Jeppson, Worcester, Mass., and L. E. Saunders, Niagara Falls, N. Y. App. filed Mar. 26, 1909. An abrasive material consisting of alumina in the form of hard, brittle crystaline grains assembled by a bond.

954,809. BONDED ARTICLE AND METHOD OF MAKING SAME; G. N. Jeppson, Worcester, Mass. App. filed Apr. 23, 1909. The method of making an abrasive from alumina which consists in melting it in a reducing furnace, crushing the product and forming the particles into an abrasive by bonding them with the flux and the re-oxidized impurities.

954,823. INCANDESCENT LAMP SOCKET; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 20, 1908. The screw threaded shell is swiveled so as to turn freely and prevent the lamp from being removed by means of a locking device consisting of a resilient strip to permit a key to unlock the parts.

954,827. ELECTRIC INDUCTION FURNACE; C. W. Soderberg, Ski, near Christiania, Norway. App. filed May 15, 1909. A disc transformer with an iron core, a hearth, a primary coil consisting of two disc coils above the hearth and disc coils below the hearth.

954,829. TELEPHONE MICROPHONE; V. Tardieu, Arles, France. App. filed Aug. 26, 1908. For solid-back transmitters, including an arm carrying a pin having insulating washers, with nuts and plates carried by the arm pressing on the pin. Details.

954,833. WIRE PLATING MACHINE; G. L. Wallace, Bridgeport, Conn. App. filed Aug. 30, 1909. A series of tanks, cleaners and polishers through which the wires are carried and subjected to a sand blast and plated.

954,838. MULTIPLE FUSE HOLDER FOR SINGLE POLE CIRCUITS; H. Wheeler, Hartford, Conn. App. filed Mar. 10, 1909. For the rapid substitution of fuses by means of a carrier having a series of fuses in pockets arranged on a rotary spindle.

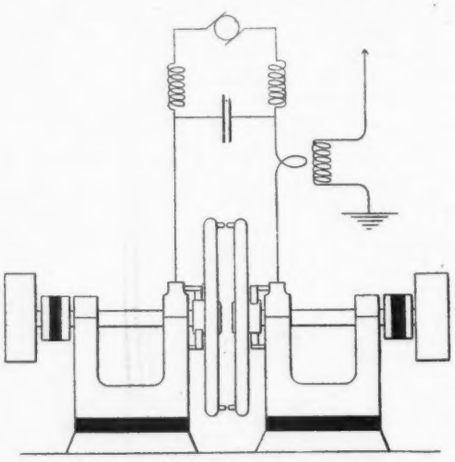
954,842. COMBINED JUNCTION AND TERMINAL BOX FOR ELECTRIC WIRES; F. C. Woods, Galesburg, Ill. App. filed June 14, 1907. For telephone cables in which the terminal box has an enlarged central aperture connected to a sleeved connector with an enlarged annular flange at the upper portion carrying a dome.

954,845. OVERLOAD PROTECTIVE DEVICE; E. F. W. Alexanderson, Schenectady, N. Y. App. filed May 15, 1905. For self-exciting alternating current generators in which the field has a rectifying commutator and a plurality of magnet windings are supplied from several phases and control independent switches with a single handle arranged to reset the switches simultaneously.

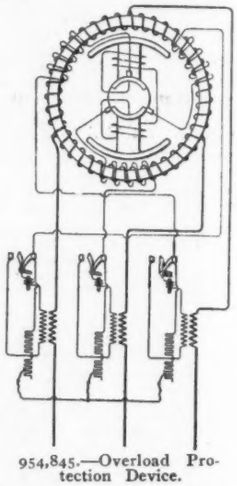
954,872. TERMINAL FOR ELECTRIC WIRES; A. R. Mosler, New York, N. Y. App. filed Nov. 19, 1908. A spark plug terminal with a plurality of fingers of elastic material for automatically attaching the terminal to a spark plug, one of the fingers having means for locking the terminal to the plug.

954,907. AUTOMATIC SAFETY DEVICE FOR TROLLEY POLES; M. M. Zellers, Belleville, Ill. App. filed Jan. 18, 1909. Drops the trolley pole when it leaves the wire by means of cross heads and springs and toggle link connections.

954,909. STERILIZING AND MUFFLING SHIELD FOR TELEPHONES; F. M. Allen, Chicago, Ill. App. filed April 9, 1908. A casing with tubular flanges for the mouthpiece and a chamber communicating with the casing and a shutter in the chamber to shut off communication between the flanges.



954,640.—Apparatus for Wireless Telegraphy.



954,845.—Overload Protection Device.

954,931. RECEIVER FOR SOUND TRANSMITTING INSTRUMENTS; J. J. Comer, Santa Monica, Cal. App. filed Mar. 4, 1907. For transmitting musical vibrations in which the receiver includes a diaphragm, an electromagnet, an armature with a bearing on one pole of the magnet and carrying a lever one end of which is connected to the diaphragm to move it.

954,997. RECORDING TARGET; J. W. Rice, Wellsville, Ohio. App. filed Mar. 1, 1909. Records the point where the target is struck by making it of sections pivotally supported with swing back to close an electric circuit to ring an annunciator.

955,035. PUSH SWITCH; C. E. Anderson, Bridgeport, Conn. App. filed Oct. 27, 1909. Push button switch of the key type, including a rocker having flanges forming sliding bearings for the key.

955,056. COMBINED TELEPHONE AND FIRE ALARM OR KINDRED SERVICE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Aug. 15, 1903. An auxiliary alarm service is provided in which the signaling currents do not interfere with talking, owing to their high frequency. The alarm receiving signal apparatus includes a relay of high self-induction and a condenser of small capacity in a bridge of the line.

955,058. CIGAR LIGHTER; C. Dinger, Sparta, Wis. App. filed May 26, 1909. A casing with a battery and coil, an ignition chamber, a gasoline tank with fulcrum posts at opposite sides of the neck, binding posts on the fulcrum posts, a torch and absorbent wick and a tapering metal head which spreads the contact parts apart on withdrawal.

955,065. INSULATOR; C. C. Hardin, La Fayette, Ga. App. filed July 22, 1909. Telegraph and telephone line insulator which holds wires of different gages and consists of a block carrying different sized grooves and mounted on a stem between which block and superimposed plates and nuts the wires are clamped.

955,101. SPARK GAP APPARATUS; W. Peukert, Brunswick, Germany. App. filed May 14, 1909. A shaft carrying a plurality of discs is rapidly rotated between electric terminals, leaving a thin layer of dielectric liquid between the terminals.